Knowledge and practices of herb-herb and herb-conventional drug interactions among traditional practitioners in Bamako, Mali

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As Partial Completion of the Master of Philosophy Degree in International Community Health

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ABBREVIATIONS

CNOP: Conseil National de l'Ordre des Pharmaciens du Mali

DMT: Department of Traditional Medicine

DPM: Direction de la Pharmacie et du Médicament

GDP: Gross Domestic Product per capita

INRSP: Institut National de Récherche en Santé Publique

ITMs: Improved Traditional Medicines

Km: Kilometer

MAO: Monoamine Oxidase

MAOIs: Monoamine oxidase inhibitors

MSSPA: Ministère de la Santé, de la Solidarité et des Personnes Agées

NGO: Non Governmental Organization

USD: United States Dollars

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Summary

Rationale: Mali is one of the poorest countries in the world with a GDP of 260 USD per capita. The public health expenditure was 10.2% of the GDP in 1999. 59% of the population has access to health facility within 15 km (1). In Mali there is since 1995 an institutional framework that regulates the practice of traditional medicine (2). In the favor of this law healers and herbalists are allowed to open traditional clinics and traditional medicines shops. To improve their state of health, people use both conventional and traditional medicines. Traditional medicine, being a significant element in the cultural patrimony, still remains the main resource for a large majority of people. The accessibility to conventional drugs is however increasing, especially in urban areas. This development can lead to the combination of the two types of medicines. According to the literature herbal medicines can interact with conventional drugs in many ways. It is therefore important to study the knowledge of herb-conventional drug interactions among traditional practitioners. On the other hand one of the objectives of the Department of Traditional Medicine is to develop new medicines (ITMs) from natural plants. The traditional healers and herbalists are the main informants for the DMT in the production of ITMs; therefore to study their knowledge of herb-herb interactions is necessary.

General objectives: The general objective was to determine the level of knowledge and the practices regarding herb-herb and herb-conventional drug interactions of the traditional practitioners (healers and herbalists) registered by the Department of Traditional Medicine (DMT) and operating in Bamako.

Study Design: Cross sectional descriptive study.

Materials and Methods: A total of 256 healers and herbalists were registered by the DMT. Out of them 123 were operating in Bamako. The sample was chosen by convenience and the participants were asked for their verbal informed consent. Interviews using a semi-structured questionnaire were performed with 22 healers and 26 herbalists from September to November 2001 supplemented by 36 consultations using a checklist with 10 healers and two herbalists. The level of knowledge of herb-herb and herb-drug interactions was categorized as low, moderate and high according to the effects reported as results herb-herb and herb-conventional drug interactions. Chi-square, Mann-Whitney and Kruskall-Wallis tests were used for statistical analysis of the data. The level of significance was set at 0,05.

Results: Healers and herbalists used four categories of medicines (herbs, ITMs, mineral elements and animal products). The herbs most frequently used were *Cassia sieberiana* DC, *Mitragyna inermis* (Willd.) O. Ktze. and *Trichilia emetica* Vahl. All the practitioners (48/48) were aware of herb-herb interactions. 69% (n=48) of the practitioners were categorized with low level of knowledge of herb-herb interactions.
58% (n=48) of the respondents were aware of herb-drug interactions. The majority 83% (n=48) of the practitioners however, scored low level of knowledge. The healers and herbalists reported thirty-two herb-herb combinations used with *T. emetica* with *Anogeissus leiocarpa* (DC) Guill. et Perrott as the mostly used. *Swartzia madagascariensis* Desv. and *Securidaca longepedunculata* Fresen. were the herbs that should never be used together or with other herbs mostly cited.
Thirteen herbs and eleven drugs were reported as those that the healers and herbalists told patients to take together, but at different times. *M. inermis* with antimalarial drugs and *A. leiocarpa* also with antimalarial drugs were the most frequently cited. *S. madagascariensis* and *S. longepedunculata* were the herbs reported as not to take with any conventional drugs.

Conclusion: The study showed that healers and herbalists have low level of knowledge of both herb-herb and herb-conventional drug interactions. The effects that they reported as results of herb-herb or herb-drug interactions were mainly the positive aspects of the interaction. However there is a room of improvement because the healers and herbalists themselves recognized that their knowledge of herb-drug interactions was low and also they were willing to get more knowledge about interactions.

Recommendations: Based on the fact that the level of knowledge of herb-herb and herb-drug interactions is low and the fact that healers and herbalists reported positive effects of interactions, we recommend:

- Training healers and herbalists about the possible consequences of herb-drug interactions as well as herb-herb interactions
- To do specific study about the interaction that healers and herbalists reported when combining herbs and herbs with conventional drugs.

Key words: Healers, Herbalists, Herbs, Improved Traditional Medicines (ITMs), Conventional Drugs, Interactions, Knowledge, Advice.

DEDICATION

To my wife Hattia Hadji BAH and my son Cheickhna BAH for their patience during my absence. To my whole family in Nampala.

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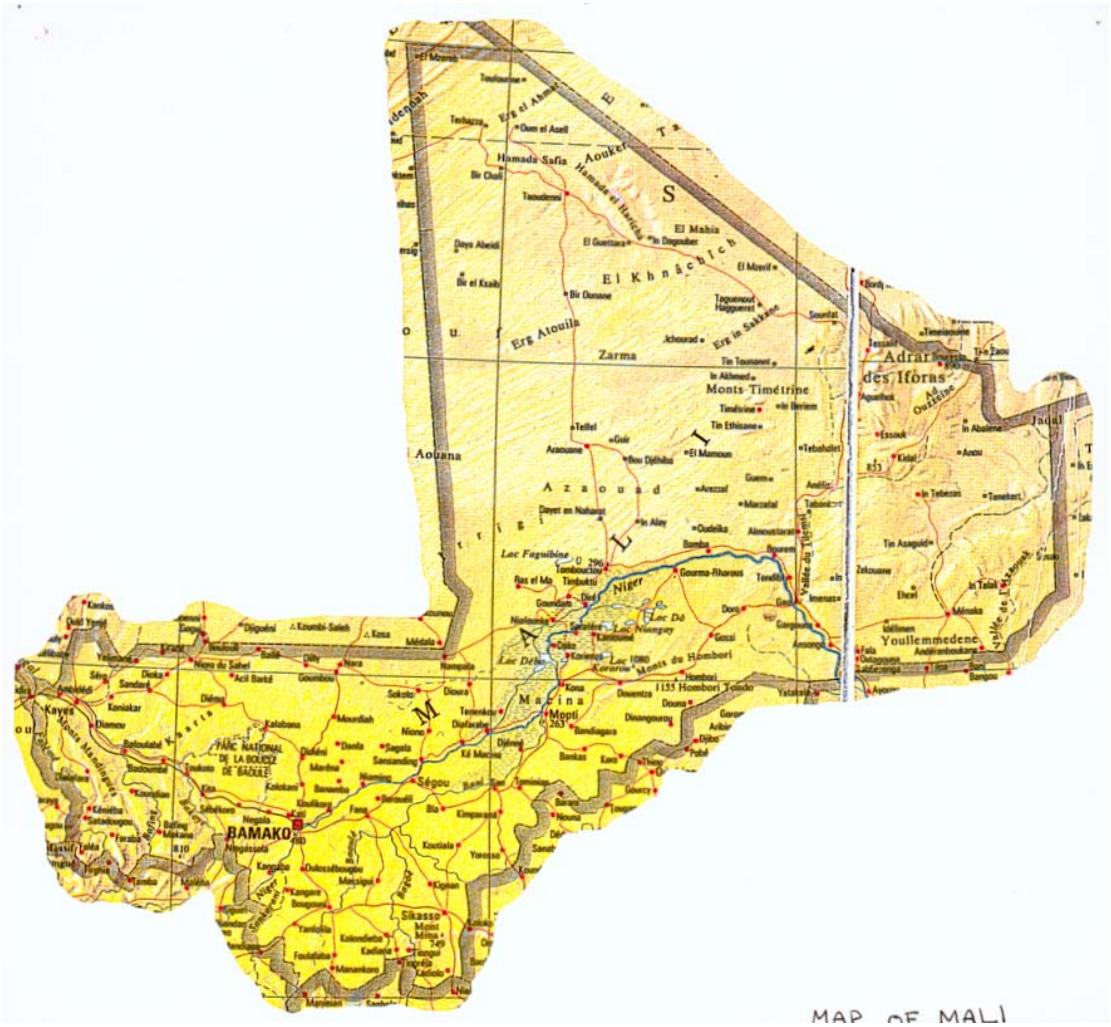
Chapter 1. INTRODUCTION

1. Country Profile. Mali

1.1. Population and geography

Located in West Africa, Mali is a landlocked country with an area of approximately 1,246,000 square km for approximately 10,900,000 inhabitants with 2,8% population growth rate per year. Mali is divided into eight administrative regions. The economy is essentially based on agriculture.



1.2. Health facilities and health indicators

The health sector policy of Mali promotes community based, self-supported health services and the administration of essential drugs including improved traditional medicines. A national essential drugs list is made with 238 molecules for all levels of

health including seven improved traditional medicines produced by the Department of Traditional Medicine (3).

The public health expenditure was 10.2% of the GDP in 1999. The country has made great progress in maternal and infant health. The infant mortality rate was 123 deaths per 1000 lives birth and the maternal mortality rate is still very high about 577 per 100000. 44% of the deliveries were assisted by a health personal in 1999. According to the Word Bank in 1996 there was one medical doctor for 16000 inhabitants and 59% of the population has access to health facility within 15 km. The school rate was low 53,9% and 54% of the total population has access to safe water (1).

1.3. Evolution of the traditional medicine sector

Traditional medicine has a long history. It is the sum total of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health, as well as in the prevention, diagnosis, improvement or treatment of physical and mental illnesses. The terms complementary/alternative/non-conventional medicine are used interchangeably with traditional medicine in some countries (4)

The practice of traditional medicine in Mali has changed along the years. According to Diallo and Paulsen (5) there are different stages in the evolution of traditional medicine in Mali: before, during and after colonization. Before the colonization traditional medicine was the only existing health care system and the traditional healer was a venerated person in the society because he possessed traditional knowledge. During the colonization the traditional healers carried out their activities in secret. Traditional medicine during this period was subject to discredit, and the colonists did not allow it. After the colonization, with the independence of most African countries a new situation emerged with tolerance of the traditional medicine. The field of research in traditional medicine has also progressed along the years. In fact, in 1968 the first institute of phytotherapy was created. It became Institut National de Récherche Sur la Medecine et la Pharmacopée Traditionnelles (National Institute of Research on Traditional Medicine and Pharmacopoeia) in 1973 (6). This institute is today called Departement de Medicine Traditionnelle (DMT= Department of Traditional Medicine). The DMT is the official institute connected to the National Institute of Research in Public Health (INRSP: Institut National de Récherche en Santé Publique). This department has as main objective the establishment of a mechanism to assure that traditional medicine is complementary to

conventional medicine, assuming that medicines can be produced from local resources, especially from medicinal plants. The main activities of the DMT are: registration of traditional practitioners, medicinal plants, research and development of Improved Traditional Medicines (ITM). The DMT has developed seven ITMs, which are acknowledged as essential medicines in Mali (7). These ITMs are *Balembo* against cough, *Dysenteral* against dysentery, *Gastrosedal* against ulcers and gastritis, *Hepatisane* against hepatitis, *Laxa-cassia* against constipation, *Malarial* against malaria and *Psorospermine* against dermatitis. Also in 1990, the African Regional Committee for WHO called the governments in Africa to elaborate appropriate policies and legislation to assure the development of national activities in traditional medicine (8). The DMT is a collaborating center of the WHO for research in traditional medicine. To give priority to traditional medicine and its practitioners two resolutions of WHO (9) (10) have advocated the integration of it in the framework of the Primary Health Care. In order to gain better control over the exploitation of the medicinal plants, the government of Mali has passed in 1994 a law establishing the regulations for the organization and functioning of private consultation clinics and traditional health care services for the traditional healers, herbalists shops and improved traditional medicines production units (11). This went into effect by an order of the Minister of Health in 1995 (2). Traditional medicine, being a significant element of the cultural patrimony still remains the recourse of large majority of the population in Mali. The traditional medicine encompasses the utilization of substances (herbs, animals, and mineral elements); dosages and practices based on socio-cultural norms and religious beliefs as well as witnessed experiences and observation of a specific group (5)

2. Literature review

The increasing use of the herbal medicine requires concern about interactions between herbs and conventional drugs and also the regulation of the herbal medicines. In 1991, WHO (12) drafted guidelines for the assessing of the herbal medicines and defined some basic criteria for evaluation of their quality, safety and efficacy. A general rule of such assessment is that traditional experience of their use and the medical, historical and ethnological background of these products shall be taken into account, through detailed descriptions in the medical or pharmaceutical literature or documented accounts of their applications. In our days a certain number of developed and even some developing countries have set policies for regulation of the traditional herbal medicines (4)

The factors affecting the safety of traditional medicines include intrinsic toxicity of the plants, adulteration, substitution, contamination, and misidentification, lack of standardization, incorrect preparation and or inappropriate dosage labeling and herbs drugs interactions.

2.1. Interactions in a pharmacological perspective

Drug interactions are defined as pharmacodynamic, pharmacokinetics or clinical responses that result from the administration of two or several drugs, which differ from the known effect of each of these drugs taken separately. The clinical effects of these interactions can be antagonistic, synergistic and additive or idiosyncratic that can lead either to treatment failure, increasing of the expected pharmacological effect or to toxic effects.

The interaction between herbs and conventional drugs may often occur because of the fact that some herbs are substituted. The addition of pharmaceutical drugs in herb products is a particular problem with Chinese patent medicines. Out of 2609 samples of traditional Chinese medicines collected from eight hospitals in Taiwan, 23.7% contained pharmaceutical adulterants, most commonly caffeine, paracetamol, indomethacin, hydrochlorothiazide and prednisolone (13)

The interaction between herbs and conventional drugs may occur in many ways. According to Brinker (14) the interactions between herbs and conventional drugs may be categorized of the following types:

- Decrease of the bioavailability of the drug: this may occur by reduction of the absorption of the drug. This is the case with for example *Amorphophallus konjac*, tea (*Camella sinensis*), guar gum (*Cyamopsis tetragonolobus*), *Plantago spp;* or by enhancement of metabolism that is the case with mustard (*Brassica spp*); or by enhancement of elimination for example by coffee.
- Increase of the bioavailability of the drug: the bioavailability can be enhanced by the increase of the absorption of the drug as with cayenne pepper (*Capsicum* spp) or black pepper *(Piper nigrum*) or by reduction in the metabolism, as with citrus and licorice. The oral drug absorption can be increased by *Zingiber officinale*. The absorption of phenytoin and propranolol is increased and the elimination of both drugs slowed when they are taken together with piperine (alkaloid from *Piper* spp).
- Protection from adverse effects: several herbs may provide protection against the adverse effects of drugs, including cayenne pepper, licorice, milk thistle (*Silybum*

marianum), and *Zingiber officinale.* The vomiting effect induced by cyclophosphamide can be prevented by prior administration of ginger acetone extract.

- Enhancement of drug effect: the effects of drugs may be enhanced by a mechanism dissimilar from that of the drug, for example, by bromelian (*Ananas comosus*). For example the hypokalemia resulting from a long term use of stimulant laxative herb potentiate the effect of cardiotonic and anti-arrhythmic drugs like quinidine (15)

- Additive effect: this effect may occur when the herb and the drug have similar activities, as it can occur with Aloe, betel nut (*Areca catechu*), gingko, licorice, gurmar (*Gymnema sylvestre*, leaves), bitter melon (*Momordica charantia* fruit and juices), and kava (*Piper methysticum*). The hypoglycemic effect of oral antidiabetic drug is increased when associated with gurmar in human clinical trial. The gurmar is used as antidiabetic remedy in Chinese traditional medicine (16). The low absorption of dietary carbohydrates can lead to the reduction of insulin dose in insulin-dependant patients.

- Antagonistic to or incompatible with drug effect: Antagonism or incompatibility may occur with betel nut (*Areca catechu* seed), mustard, and papaya (*Carica papaya*). In human case report (per os) the antiparkinsonian effect of phenothiazines such as flupenthixol and fluphenazine and anticholinergic effect of procyclidine are reduced when administrated with arecoline and that could be due to the cholinergic effect of the later.

De Smet and d'Arcy have used a different categorization to classify herb-conventional drug interactions (17). Brinker (18) in his review has described the well-known and possible interactions between herbs and conventional drugs. It is well documented that the laxative-containing herbs decrease the absorption of orally taken drugs (19).

When it comes to the herb-herb interactions there are few data. Many traditional medicines consist of admixtures of herbal ingredients in complex formulas; there may be synergism or antagonism between components. In addition new chemical complexes are probably produced from the interactions of these ingredients. The alkaloid berberine can combine with glycyrrhizin found in licorice form a new chemical with potentially different pharmacological property (17). A Chinese herbal medicine *Scutellaria* constituent, baicalin, a flavonoid glucuronide, can complex with berberine (19).

The most common components reported in the literature to be responsible of herb-drug interactions are fibers, tannins, anthraquinoids, heterosides, alkaloids, coumarins, polysaccharides, mineral elements etc. These substances are biologically active and responsible for the therapeutic effect of the medicinal plants (herbs).

2.2. Reviews and studies about herb-conventional drugs interactions

One of the shortcomings of many of the reports of purported herb drug interactions is the lack of documentation of the source of information (19). The most common ways to assess the possible interactions between herbs and conventional drugs as suggested by Brinker (14) are in vitro, animal studies, speculative, empirical knowledge, human studies and human clinical studies. Most of the studies that revealed the evidence of herb-conventional drug interactions have been done by one the above-cited methods. Some mechanisms of herb-drug interactions have been well described. Some well-characterized interactions exist, some other are not clearly defined.

The interactions between herbs and conventional drugs have been reported either with the crude materials of the plants and the extracts or the isolated ingredients.

The next part will give some examples of studies and reviews about the interactions between herbs and conventional drugs.

Animal in-vitro experiments

Many studies have been done to evaluate the interactions between herbs and conventional drug (20) (21) (22) (23). In this part I shall report some of them:

The Diabecon 400, an Ayurvedic antidiabetic herb, has been found to increase significantly the plasma levels of tolbutamide and glybenclamide in rabbits and this due probably to the inhibition of the hepatic cytochrom P450 (21). Another experiment on rat missed to show the significance of the effect of the herb on the plasma levels of nifedipin and rifampicin (20).

Zhu M. and al (22) have investigated the significance of an interaction between Ciprofloxacine and *Sanguisorba officinalis* L *(SO)* by using a pharmacokinetic approach. The aqueous extract of roots and rhizomes of the plant was used. Male Sprague-Dawley rats were used (five in each group). In the test group the SO dose (2g/kg) was given followed by a single dose of Ciprofloxacine (20mg/kg). The control group was receiving only a single dose of Ciprofloxacine. The way of administration was oral route. Blood and urine samples were collected at regular intervals in order to determine the Ciprofloxacine pharmacokinetics. Findings of this study suggest that if Ciprofloxacine is to be used concurrently with herbal drugs containing high mineral content, sufficient time between administrations should be allowed to reduce the possibility of the interactions between them.

A study on rat that has been reported by De Smet (17) has shown that tannin-containing herbs can reduce the absorption of antipsychotic drugs such phenothiazines, amitryptilline by formation of non-absorbable precipitates. These precipitates are non-dissolvable in hydrochloric acid that can reduce their absorption.

The absorption of sulfaguanidine might be enhanced by *Zinziber officinalis* according to experiments on rat (19)

The in-vitro experiments have some limitations because the extrapolation of the results to clinical effects is difficult due for example to the biological differences between human and rats and rabbits. Therefore the laboratory tests results should be confirmed by clinical trials.

Clinical studies and cases reports

Herb-drug interactions have also been proven by some clinical trials. A book published by WHO listed some of the well-established interactions between herbs and conventional drugs (24)

It has been reported that patients on warfarin therapy should be warned that garlic supplements (*Allium sativum* L) might increase bleeding times; also blood clotting times have been reported to double in patients taking warfarin and garlic supplements (25).

The active ingredient of St John wort *(Hypericum perforatum*), hypericin, causes irreversible inhibition of Monoamine oxidase (MAO) both types A and B with higher activity toward B. Therefore this herb should not be used with Monoamine Oxidase Inhibitors (MAOIs). St John wort has shown a property to decrease the cyclosporine concentration in a patient who has undergone kidney transplantation (26).

It is also reported by many studies that *Hypericum perforatum*, *Allium sativum*, *Gingko biloba*, *Cassia senna* and *Rhamnus purshiana* may interact with warfarin (27).

Also it has been cases of adverse reactions in patients undergoing anesthesia while taking MAOIs (Monoamine Oxidase Inhibitors). In fact a 21 year-old patient who is using a MAOI developed hypotention and bradycardia while under spinal anesthesia. Based on this, Kappouris has raised the worry about the use of St John Wort by patients who seek anesthesia. The recommendation he made was that it should be wise for patients taking this drug to observe precautions appropriate for conventional MAOIs and the same applies to anesthetic practice. In addition, there should be an increased awareness of self-medication with herbal adjuncts in the anesthetists' pre-operative assessment (28). The limitation related to the clinical studies is that the samples in these are usually very small

to be generalized to large populations. Many of the interactions between herbs and conventional drugs came also from individual case reports.

The interactions between herbs and conventional drugs have also been addressed by many other ways in the literature (29) (30). In Australia for making guidelines about drugs and herbs interactions, Braun made the list of the 21 commonly used herbs and the 12 most prescribed drugs in the country and at the same time he consulted the available literature on the herb-conventional drug interactions (31). Fugh-Berman (27) has published a review about interactions between herbs and conventional drugs. For the sake of this review she looked into electronic databases like Medline and EMBASE to describe some reported interactions between herbs and conventional drugs. More recently Fugh and Ernst (30) have published a review that described some herb-drugs interactions reported and discussed the reliability of the reports on herb-drugs interactions.
When it comes to interactions between herbs and conventional drugs, most of the studies have been carried out in the developed countries and are carried out on Ayurvedic or Chinese traditional herbs. There is a crucial lack of documentation about the African herbal medicines regarding the interactions. We remark that the issue concerning interactions between different herbs and between herbs and conventional drugs requires a combination of many methods.

2.3. Knowledge and practice among traditional practitioners concerning interactions

The documentation of the knowledge and practice of traditional practitioners concerning interactions is rare. The herbalists generally use unpurified plant extracts containing several different constituents. They claim that these can work together synergistically so that the effect of the whole herb is greater than the summed effects of its components. They also claim that toxicity is reduced when whole herbs are used instead of isolated active ingredients “buffering”. By combining herbs the practitioners claim that the combination improves the efficacy and reduces adverse effect (32). Chinese traditional practitioners have knowledge about the interactions between different herbs. They divide it according to four mechanisms: Xiangfan (incompatibility) or Xiangwu (antagonism), Xiangha (detoxification) or Xiangwei (inhibition), Xiangshi (enhancement), Xiangxu (synergism) (33)

3. Rationale of the study

In developing countries like Mali the use of traditional medicine is very important because for example of the non-accessibility of the majority of the populations to modern biomedicine in general and to essential drugs in particular. The accessibility to conventional drugs and modern biomedicine cares in urban areas is however high as compared to rural areas. This phenomenon can lead to the mixture of the two types of medicines in urban cities. Since herbal medicines and conventional drugs can interact in many ways, it is therefore important to consider the issue of herb-drug interactions in Mali. In Mali in 1994 the devaluation of the currency has led people to return back to the traditional medicines. In many developing countries, the use of traditional medicines could have been common among patients with chronic illnesses (heart diseases, diabetes, hepatitis etc).

After consulting the literature, no study was found focusing on the knowledge and practice of the traditional practitioners about interactions between different herbs and between herbs and conventional drugs. All the studies were on clinical trials, in-vitro experiments, and review of the literature or editors' letter (34). In Mali, to improve their state of health, people use both conventional and traditional medicines. The traditional practice of medicine has changed along the years. In Mali now the practice of traditional medicine is meeting the practice of modern biomedicine and this phenomenon leads people to use both herbal medicines and conventional drugs in combination. There is a need to assess the knowledge of the healers and herbalists about the interactions between herbs and conventional drugs and between different herbs as well.

The medicinal plants used in Malian traditional medicine may contain most of the substances reported as responsible for herb-conventional drug interactions. In Mali many studies have been carried out on the phytochemistry and pharmacology of some medicinal plants (35). Another issue of the interaction between herbs and conventional drugs is that the users of herbs and herbal products do not report this use to their doctors' (36) (29) (27). This phenomenon can also be the case in many developing countries especially in Mali where the self-medication is very high (37)(unpublished data). It is likely that the users do report some cases of drug-herb interactions to their local traditional healers or herbalists. Regarding the rational use of the herbal medicines with conventional drugs, many authors have made some suggestions. Some of them have recommended the sensitization of the patients, nurses and clinicians (38) (27). Fugh-

Berman (27) has suggested that the patients might not be telling about the negative experience with herbal medicine, even if it causes severe adverse effects, because they fear negative reactions from their clinicians. Clinicians therefore must ask the patients about their use of herbs in a non-judgmental, relaxed way: a disapproving manner will ensure only that a patient will conceal further use. The patient should be treated as a partner in watching out for adverse reactions or interactions, and should be told about problems that may arise due to the lack of communication about the use of herbal medicine.

In Mali, the self-medication is high and also the majority of the people use the traditional medicine. Since there are potential interactions between herbs and drugs it is important to conduct a study on knowledge and practice of traditional healers and herbalists about herb and conventional drug interactions.

Since 1995 there is in Mali an institutional frame of the practice of traditional medicine that allows healers and herbalists to open traditional health clinics and traditional medicine shops. Since there is potential interaction between herbs and between herbs and conventional drugs, the assessment of their knowledge and practice about interaction different herbs and between herbs and conventional drugs is needed.

The results of the study may give the DMT some directives about the future research toward the production of improved traditional medicines and to establish better collaboration between traditional practitioners and the DMT. The results will contribute to give information to healers and herbalists about possible interactions between different herbs and between herbs and conventional drugs as well. The results of the study will also be used to sensitive the health workers, clinicians and nurses, in the possibility of collaboration between them and the traditional practitioners. The results of the study will also be reported in French that is the official language in Mali. Therefore the decision-makers will easily understand the recommendations that will be made based on the results of the study. The results of the study will be presented to the Department of Traditional Medicine and to the Associations of Healers and Herbalists in Bamako.

Chapter 2. HYPOTHESIS AND OBJECTIVES

1. Hypothesis

In Bamako traditional healers and herbalists are supposed to have low level of knowledge and poor practice of herb-herb and herb-conventional drug interactions.

2. Research questions

What are the levels of knowledge of traditional healers and herbalists of Bamako of herb-herb and herb-conventional drug interactions?

What are the practices of healers and herbalists of Bamako about herb-herb and herb-conventional drug interactions?

3. Objectives

The following objectives are fixed in order to conduct this study:

3.1. General objectives

The overall aim of this study is to determine the levels of knowledge and the practices of healers and herbalists about herb-herb and herb-conventional drug interactions and also to make recommendation for better use of the traditional herbal medicines with conventional drugs in Mali.

3.2. Specific objectives

1. To determine the level of knowledge of herb-herb interactions of healers and herbalists registered by the DMT and operating in Bamako
2. To determine the level of knowledge of herb-drug interactions of healers and herbalists registered by the DMT and operating in Bamako
3. To determine the types of medicines used by healers and herbalists registered by the DMT and operating in Bamako
4. To determine the herbs most frequently used by healers and herbalists registered by the DMT and operating in Bamako.
5. To determine the herbs that can interact
6. To determine the herbs that can interact with conventional drugs
7. To determine the herbs that healers and herbalists registered by the DMT and operating in Bamako ask patients to take together

8. To determine herbs that healers and herbalists registered by the DMT and operating in Bamako ask patients to take together with conventional drugs.

9. To determine the herbs that healers and herbalists registered by the DMT and operating in Bamako never use together.

10. To determine the herbs that healers and herbalists registered by the DMT and operating in Bamako never use with conventional drugs.

11. To determine the information of relevance for interactions that healers and herbalists registered by the DMT and operating in Bamako collect from their patients

12. To determine the advices that healers and herbalists registered by the DMT and operating in Bamako give to their patients about herb-herb and herb-drug interactions.

13. To make recommendations in order to improve the quality of use of traditional medicine in Mali.

Chapter 3. METHODOLOGY

Two methods were used for data collection during our study: cross-sectional survey and non-participant observation. Two techniques of data collection were used:

- A semi-structured interview based on a questionnaire. The questionnaire was addressed to 22 healers and 26 herbalists; both registered by the Department of Traditional Medicine (DMT) and operating in Bamako.
- A checklist was used for gathering observational data during 30 consultations among ten healers and six consultations among two herbalists.

1. Study area and population

1.1. Study area

The fieldwork of the study was carried out in Bamako, Capital City of Mali, from September 2001 to December 2001. About 900,000 people live in Bamako. Two of the three national hospitals, Hôpital du Point G (Point G hospital) and CHU Gabriel Touré (Centre Hospitalier Universitaire Gabriel Touré) are located in Bamako. Bamako accounts six municipalities with a health center for each of them (Referral Health Centers). There are also 47 Community Health Centers (Centre de Santé Communautaire) (39), two-referral centers on maternal health with six PMI (Protection Maternelle et Infantile = Child and Mothers Clinic), 165 private pharmacies in Bamako and 13 associations of healers and herbalists operating in Bamako. A total number of 256 healers and herbalists are registered by the DMT. Out of them 123 were operating in Bamako. 21 traditional medical care clinics and seven herbal units exist in Bamako (39). In Bamako people have access to both conventional drugs and traditional herbal medicines. This justified the choice of Bamako for our study.

1.2. Study Population

1.2.1. Definition of study population

Herbalists and healers registered by the DMT and operating in Bamako composed our study population. Some definitions need to be given. In 1994 the government has passed a law that defined the different traditional practitioners.

Traditional healer: Healer is defined as a person who is recognized by the community where he lives having competence to provide traditional medicine care (2). According to the 1995s law healers as well as herbalists are allowed to open traditional medicine clinics and herbal medicine shops.

Herbalist: In the larger cities of Mali, merchants called herbalists sell medicinal plants (2). The medicines consist of plant material in their natural form or plant substances that have undergone preliminary processing such as pulping or pulverization. In Bamako, there is collaboration between DMT, herbalists associations and the NGO Terra Nova to improve the sanitary conditions around the sale of the plant medicines, and the shops owned by individual herbalists have been renovated. Drying and storage of plants have also been improved. Since 1995 with the favor of the new law, the students graduated from the Institut Polytechnique Rural (Institute of Rural Polytechnic and from the faculty of Biology at the University can also open their own shops of traditional herbal medicines (2).

There are some requirements for a healer or herbalist to be recognized and open a clinic or shop. The healer should send his medicines to the DMT for toxicity investigation and phytochemical characterization. He might also get a certificate from the local physician of the area where he working.

Inclusion criteria

- The healers and herbalists registered by the Department of Traditional Medicine and operating in Bamako were included in the study.
- The healers and herbalists registered as members of associations of traditional practitioners
- The healers or herbalists who were willing to participate to the study

Exclusion criteria

- Healers and herbalists not registered and not operating in Bamako.
-Healers and herbalists with no fixed address i.e. the ambulant practitioners: there are practitioners who walk with their products from door to door around the city.
- Traditional Birth Attendants
- Spiritual healers

- Foreigner healers and herbalists
- Healers and herbalists included in the pilot study

The choice of the healers and herbalists operating in Bamako and registered by the DMT is justified by the fact that they are easy to find and that they collaborate with the department of traditional medicine. Therefore they are supposed to have participated in some activities run by the department and some other institutions working for promoting traditional medicine practice. The DMT and other health institutions used to organize workshops on the collaboration between the traditional and modern medicines. Healers and herbalists registered by the DMT are usually participants to these meetings. In this collaboration the DMT trains healers and herbalists on the production of Improved Traditional Medicines (ITMs), techniques of harvesting and drying of medicinal plants. Those are therefore supposed to be more sensitive to the phenomenon of herb-conventional drug interactions than others living in the countryside. These herbalists and healers are not representative of all healers and herbalists in Mali. But for lack of resources and time we could not do a study involving all the healers and herbalists in Mali.

1.3. Selection and sample size

Once in the field, we found that the registration of the practitioners was not completed or updated. We found four sources of data about the practitioners: DMT, CNOP (Conseil National de l'Ordre des Pharmaciens du Mali i.e. National Board of Pharmacists), Conseil de l'Ordre des Medecins (National Board of General Practitioners) and the General Secretariat of the Ministry of Health. We collected the data from all those sources by using the DMT list as reference (i.e. we were confronting the practitioners found in other sources with those found in the DMT); in order to fit with our inclusion criteria. Some healers and herbalists were mentioned twice or four times with different addresses. Some of them also were not in Mali because they have moved to the neighboring countries. To identify the healers and herbalists to be included in the study, we sent the list of the registered healers and herbalists to all representatives of the associations of healers and herbalists. Those representatives were asked to check out their respective members.

A total of 256 healers and herbalists were found registered by the DMT (data from the DMT). Out of those 123 were operating in Bamako. In conformity with our exclusion criteria the following healers and herbalists were excluded from the sample:

- 13 foreigners: five Chinese, two from Ghana, two from Cameroon, three from Burkina Faso and one from Ivory Coast.
- Five healers and herbalists had moved from Bamako to other countries or to the countryside.
- Three were identified as dead
- Two who were registered with two different associations: those two healers were registered twice in two associations and we preferred to exclude them because it could have been very difficult to find them.
- Five healers and herbalists newly licensed (1 healer and four herbalists). Those had not yet started to operate.
- Five included in the pilot study (two herbalists and three healers).
- Ten were not belonging to any association: the association representatives did not identify them as members of their respective association.
- Ten belonged to traditional ophthalmologists associations and other associations who refused to answer our request.
- Ten practitioners refused completely to take part in the study: some healers and herbalists for some reasons refused to participate in the study from the beginning.
- Five who said they would prefer to fill in the questionnaire themselves: they never sent the questionnaire back to us.
- Five dropout: three for observation and two for the interview: those healers and herbalists had started the study but in the middle of the data collection they dropped.
- Two were not identified: we were not able to find those healers and herbalists.

A total of 48 interviews and 36 observations were done.

2. Method

For the purpose of this study a quantitative method has been used, supplemented by an observation of the healers and herbalists in their practice.

2.1. Pilot study and training of the research assistant (second interviewer)

The pilot study was conducted with five (three healers and two herbalists) eligible participants before the start of the data collection. Two (one healer and herbalist) participants in the pilot study had been to school. After the pilot study some changes were made on some alternative answers and some modifications in the questionnaire (see results of pilot study). The main researcher did the pilot study alone. After the pilot study,

the advisor in Mali Drissa Diallo, my self and the researcher assistant agreed on the same way on asking the questions.

The training of the research assistant was done after the pilot study. The research assistant was a female nurse. She had participated as interviewer in some surveys performed by NGOs (like Save the Children UK) operating in the health domain in Mali. The choice in her was partly motivated to get more information from the females practitioners. During the training sessions the research assistant was instructed to report exactly what the respondents answered. The training session of the assistant took two days and was focused on how the questions should be asked most especially for the open ones (not asking leading questions) and about the ethical consideration of the study. My advisor in Mali Drissa Diallo, the assistant and myself confronted the questionnaire responses and agreed on their translation.

2.2. Cross-sectional survey

Many cross-sectional studies are descriptive, and these are called surveys. In a cross-sectional study all the information is collected at the same time because the subjects are only contacted once. This can help to assess the situation under investigation at one specific time. The cross sectional design is also suitable for assessing the quality of care and the determination of knowledge and practice or behavior. Since the study is aimed to assess knowledge and practice, the use of cross sectional design is therefore comprehensible. Since in Mali there is no previous study about the interactions between herbs and conventional drugs, the cross-sectional design is suitable for getting some baseline data. The quantitative method helps to determine the type of medicines used, to determine the level of knowledge of the healers and herbalists about interactions between different herbs and between herbs and conventional drugs as well as their practice.

Questionnaire is used to test knowledge and practice. The knowledge questions are included in surveys to achieve the following objective (40)

- To determine if people have enough knowledge about a topic that necessitates asking their opinion about it. The healers or herbalists might get knowledge about interactions from their own experience, from parents and from the workshops organized by the DMT or from other institutions.
- To identify gaps in knowledge that warrants education, advertising, or publicity or other kinds of information campaigns. The healers or herbalists may have got knowledge either from school, NGOs, DMT, etc.

- To help to explain attitudes and behavior. The practice of the healers and herbalists might be influenced by the knowledge they have concerning interactions.

In our study the level of knowledge will be defined according to how the healers and herbalists interpret the mechanisms of herb-herb and herb-conventional drugs interactions (the effects that might occur when two herbs are taken together or when an herb is taken with a conventional drug).

2.2.1. Questionnaire: material and data collection

A total of 48 interviews were done with 22 healers and 26 herbalists.

The questions were of two types: open and closed. (Annex 1). Some of the questions were general because the healer and herbalist can be reticent on answering some specific questions related to their knowledge. To improve the questions, a pilot study was performed. Some neutral category answers were included in the questionnaires. This will give to people with no opinion, a choice. These are for example "Don't know".

The questionnaire contained five main parts (Annex 1):

- Socio-demographic information of the respondents (the Section A)
- The categories of medicines used: section B of the questionnaire (annex1)
- Knowledge about herb-herb and herb-drug interactions (Section C)
- Practice about herb-herb and herb-conventional drug interactions. The practices were defined as the herbs that they are not combining together, the herbs they combine with conventional drugs, the herb they are not combining with conventional drugs (section D) (annex1), the advice they give to patients about herb-herb and herb-drug interactions (section D) (annex1) and the relevant information about herb-herb and herb-drug interactions collected from the patients before given them herbs (section D) (annex1). Some questions about practice were located in sections B, C and D.
- The last section (section E) of the questionnaire presented some statements on herb-herb and herb-drug interactions that the respondents should report their degree of agreement with.

Face-to-face interviews were used to collect the data for the quantitative part of the study (survey questionnaire). The same questionnaire was used for both healers and herbalists. The reasons for doing so was that both healers and herbalists were supposed to have low knowledge and poor practice also both use herbal medicines. In addition sometimes healers are registered as herbalists and vice versa. Some practitioners are registered as

healers while they considered themselves as herbalists or vice versa. Two persons had done the interviews: the main researcher and a research assistant. The research assistant and the main researcher did together the 10 first interviews. The research assistant interviewed alone 22 respondents while the main researcher interviewed alone 16 respondents. During the whole period of data collection, every evening after interviews, the research assistant and the main researcher looked together through the answers and confronted them. This permitted us to look closely at the missing answers in order to increase the response rate.

The average time for one interview was three hours because the healers and herbalists were interviewed in their work place (they can start the interview and stop for either selling their medicines, consulting patients or praying or going to another social gathering). For some of them the interview took two days because sometimes they requested us to go and come back next day.

2.2.2. Definition of variables

2.2.2.1. Independent variables

Sex and age: The sex of the practitioners was reported because according to the literature the majority of the herbalists were females. This variable might influence the level of knowledge. Age also is an important variable because the young might want to know about new phenomenon rather than old. Therefore the age of the respondents could be important.

Profession: The respondents were asked to say to which profession they considered them selves to belong to. This was important because some practitioners were registered in the DMT as healers while considering themselves as herbalists and vice versa.

Membership of an association: By this we mean if the healer or herbalist is member of any association of healers or herbalists. The appurtenance to an association is an important variable for two reasons: first the associations are collaborating closely with the DMT, which might increase their level of knowledge and improve their practice about interactions, secondly the feedback may be given to them through the respective associations they belong to.

Attendance to a workshop on the collaboration between traditional medicine and modern biomedicine: This was an important variable for us because it could help us to see whether the level of knowledge is influenced by the topics discussed during those workshops. The workshops organized had as topics: disease control, ITM production and other topics of relevance for interactions. This could help us to identify the reasons that lead healers and herbalists not to participate to the workshops.

Professional Background*:* The healers and herbalists were asked about their traditional medicine practice background. The practitioners were categorized as with inherited background or with no inherited background. By practitioner with inherited background, we mean healer or herbalist who comes from a family that practices traditional medicine. By practitioner with no inherited background, we mean the healer or herbalist who comes from a family that does not practice traditional medicine. The background was supposed to have an impact on the level of knowledge of the interactions between different herbs.

Years in formal schooling: The practitioners were asked to report the number of years in formal school. The answers were categorized as follows:

- Never (never been to school)
- 1-6 years in school (first cycle)
- 7-9 years in school (2nd cycle)
- 10-12 years in school (secondary school)
- More than 12 years in school (university)

The educational attendance is an important factor that can contribute to increase the level of knowledge of healers and herbalists of herb-herb or herb-drug interactions and also to improve their practice about interactions.

Alphabetization in Bambara: This was defined first by asking the practitioner whether he/she had attended any alphabetization course in Bambara. Since one of the objectives of the study is to give recommendation, the skill in the main language was important. Handbooks, manuscripts and other supports could be used in order to give information to the healers and herbalists only to the extent they are capable of reading. The feedback could be given to them according to their skill in Bambara.

***Length of time in the practice (experience)**:* By this we mean the time the healer or the herbalist has been performing his work. The healers and the herbalists were categorized as with:

- Five years or less in work
- More than five years

The experience the healer or the herbalist has got from his work may contribute to increase his level of knowledge and improve his practice.

***Source of information about interaction**:* By this we mean the source from which the healer or herbalist has knowledge about herb-herb and herb-conventional drug interactions. This could help us to know the best way through which the information about interactions should be given to the healers and herbalists.

2.2.2.2. Dependent variables

Level of Knowledge of herb-herb interactions

In our study this was defined according to what healers and herbalists think are the results of interactions between two herbs. In other words the effects reported by healers and herbalists that could occur when two herbs are taken together.

Scoring of the level of knowledge of herb-herb interactions

The level of knowledge of herb-herb was examined through one question in the question (qn.1 of section C1, annex1). The practitioners were asked to give the effects that can occur when two herbs were taken together. After data collection, seven alternative answers (effects) were used for categorizing the level of knowledge of herb-herb interactions. This categorization was done according to the effects reported by practitioners as results of interactions between two herbs. Each answer was given 1 point except don't know that equaled to 0 point. Healers and herbalists were scored from 0 to seven points for herb-herb. The level of knowledge of herb-herb interactions was categorized as follows:

- Low knowledge: Healers or herbalists who scored 0-1 point.
- Moderate knowledge: Healers or herbalists who scored 2-4 points
- High knowledge: Healers or herbalists who scored 5-7 points.

Level of knowledge of herb-conventional drug interactions

In our study this level of knowledge was defined according to what healers and herbalists think are the results of interactions between herb and conventional drug. In other words the effects reported by healers and herbalists that could occur when an herb is taken together with a conventional drug.

Scoring of the level of knowledge of herb-drug interactions

The level of knowledge of herb-drug interactions was examined through one question in the questionnaire (qn.1 section C2, annex1). The practitioners were asked to report the effects that could occur when an herb is taken together with a conventional drug. After data collection, eight alternative answers (effects) were used for categorizing the level of knowledge of herb-drug interactions. This categorization was done according to the effects reported by practitioners as results of herb-conventional drug interactions. Each answer was given 1 point except don't know that equaled to 0 point. Healers and herbalists were scored from 0 to eight points for herb-drug. The level of knowledge of herb-drug interactions was categorized as follows:

- Low knowledge: Healers or herbalists who scored 0-1 point.
- Moderate knowledge: Healers or herbalists who scored 2-4 points
- High knowledge: Healer or herbalist who scored 5-8 points.

Practice

By practice we mean what healers and herbalists do according to what they know. The following variables were used to determine the practice:

- Most frequent herbs used by practitioners. By this we mean the herbs that the practitioners reported being the most frequently used.

- Quality of practice related to the advice. By this we mean the advice that practitioners give to patients when giving them herbs. Healers and herbalists were asked what advice they gave to their patients when offering them herbs. The respondents reported all together eight different advices. Each advice provided was allocated 1 point. The respondents, who did not give any advice, were allocated 0 point. The quality of the practice was categorized in the following manner:

- Poor practice: 0-3 points
- Good practice: 4-6 points

- Very good practice: 7-8 points

- Information of relevance for interactions that the practitioners collect from their patient. By this we mean the information that the practitioner thinks is important for interactions and asks the patients about.

- Herb-herb combinations. By this we mean the herbs that practitioners advise patients to take together.

- Reasons for taking different herbs together. By this we mean the results (effects) the practitioners expect when they tell patients to take different herbs together. These effects were categorized according to the clinical outcome. These are increased recovery, complementary effects, increased effects, increased side effects and decreased effects.

- Herbs that can never be taken together. By this we mean the herbs that practitioners never use together.

- Reasons for not taking different herbs together. By this we mean the effects that occur from the interaction between herbs that should never be taken together. These effects are categorized clinically: the mild effects (diarrhea, vomiting, headaches, and dizziness), severe effects (profuse diarrhea, increased toxicity, and death) and other effects (cancelled effects, etc).

- Herb-drug combinations. By this we mean the herbs and conventional drugs that practitioners advise patients to take together.

- Herbs and drugs that can never be used together. By this we mean the herbs and conventional drugs that practitioners say should never be taken together.

- Reasons for not taking herbs with conventional drugs. By this we mean the effects that occur from the interaction between herbs and drugs that should never be taken together. These effects are categorized clinically: the mild effects (diarrhea, vomiting, headaches, and dizziness), severe effects (profuse diarrhea, increased toxicity, and death) and other effects (cancelled effects, etc).

In the coming section I shall present practice related to the advices given when it comes to the use of specific types of conventional drug: oral conventional drug with laxative herb and drug that has same activity as the herb that the practitioner gives to his patient.

- Quality of practice related to advice given to a patient concerning the use of oral conventional drug with laxative herb. By this we mean the advice that the healers and herbalists were giving to patients taking oral drug when the herb has laxative effect. The practitioners reported seven different answers (advices). The practitioners were categorized in the following way:

- Poor practice: A healer or herbalist is considered having poor practice when he/she mentioned one of the following advices:

* Don't know
* Take both products (herb and conventional drug) at the same time

- Good practice: A healer or herbalist is considered having good practice when he/she mentioned one of the following advices:

* Take them at different times by observing long time between the two products
* Stop one of them

- Quality of practice related to advice given to a patient taking a conventional drug that has the same activity as the herb given. By this we mean the advice that the healers or herbalists are giving to patient regarding the use of herb that has the same effect as a conventional drug. Eight different answers (advices) were reported. The practitioners were categorized as follow:

- Poor practice: A healer or herbalist is considered having poor practice when he/she mentioned one of the following advices:

* Don't know
* Take both products (herb and conventional drug) at the same time

- Good practice: A healer or herbalist is considered having good practice when he/she mentioned one of the following advices:

* Take them at different times by observing long time between the two products
* Stop one of them

2.2.3. Other operational definitions

Improved Traditional Medicines (ITMs): ITMs are defined as medicines made from the plants by adding some chemical substances in order to get pharmaceutical forms such as syrup, ointment, and capsules.

Herbs: Herbs are defined here as the medicinal plant presented in his natural form. According to the law in Mali (2) medicinal plant is defined as the whole plant or part of the plant used on its natural form. The herbs can be sold in the following forms:

- Tisane: A tisane is defined as the medicinal plants sifted carefully, dust free and packed into a closed sachet.
- Powder: is the plant dried and pulverized.

2.3. Non participant observation

According to Astier M. Almedom (41) "*Observation is a standard anthropological method for gathering information. It is a relatively unobtrusive and highly effective method that is often combined with other methods, such as interviewing. Observation can be done in a structured way, using a set of pre-selected things to observe or in an unstructured manner by noting down everything observed and then classifying the information according to relevant themes. When the study objectives are specific, clearly defined, and the time allowed for the study is limited, structured observations are more appropriate than unstructured ones. Spot-check observations are the simplest type of structured observations that can be conducted during a health walk, as well as during household visits and when interviewing. A structured spot-check observation schedule may be prepared, that consists of a list of relevant things to look for*". The observational method used in this study was a non-participant observation. It helps us to observe what the practitioners are really doing. The validity and the reliability of a non-participant observation depend a lot of the clarity of the points on the checklist. The skill of the observers is also required. To reduce the biases that may occur during the observation, the main researcher did alone the observational part of the study. The non-participant observation also makes comparison with the answers from the questionnaires possible.

Checklist: materiel and data collection

The observation was used to determine the practice of the observed healers and herbalists about herb-herb and herb-conventional drug interaction. The observation was made before the quantitative study in order to avoid biases created by the interview itself. The data were collected during the observation by using a checklist. The checklist had eight points for the herb-herb interactions and seven points for herb-drug interactions. A non-participant observation was used; this means I was observing what the healers and herbalists were doing without asking any question related to the point observed. Each healer or herbalist was observed or visited three times. A total of 36 consultations were done (30 consultations with ten healers and six visits to herbalist shops). Before starting the observation, the respondents were asked about their consent. The following points were observed

The eight points checked for herb-herb interactions during the consultations using the checklist

1. Whether the healer or herbalist asks the patient if he is taking another herb before giving him herbs Yes (1) No (0)
2. The healer or herbalist asks patients about the type of herb the patient is taking Yes (1) No (0)
3. If the healer or herbalist indicates the side effect of the herb he is giving Yes (1) No (0)
4. If the healer or the herbalist informs the patient about the side effect related to the combination of herbs he is giving Yes (1) No (0)
5. If the healer or the herbalist gives directives on how to take the two or more herbs Yes (1) No (0).
6. If the healer or the herbalist informs the patient to come back in case of interactions Yes (1) No (0).
7. If the healer or the herbalist tells the patient a list of herbs that cannot be taken with the herb given Yes (1) No (0)
8. If the healers or herbalist tells the patients a list of foods that cannot to be taken with the herbs Yes (1) No (0).

The seven points checked for herbs-drug interactions during the consultations using the checklist

1. The healer or herbalist asks the patient if he has visited a modern biomedicine worker (doctor or pharmacist) Yes (1) No (0)
2. Whether the healers or herbalists asks patients if they are taking a conventional drug before giving them the herbs Yes (1) No (0).
3. Whether the healer or herbalist asks about the type of conventional drug the patient is taking (the drug is against which disease) Yes (1) No (0)
4. Whether the healer or herbalist asks how the conventional drug is taken (oral, injection, topical) Yes (1) No (0)

5. If the patient is taking conventional drug(s) and herb (s), if the healer or herbalist give instructions on how to use the combination: - stop/reduce the conventional drug, - take together with intervals, etc Yes (1) No (0).
6. Whether the healers or herbalists inform their patients about the side effects related to the association of herbs with conventional drugs Yes (1) No (0).
7. If the healers or herbalist tells the patients some conventional drugs that can never be taken together with the herbs he gives Yes (1) No (0).

3. Validity, reliability and representativeness of the data

The questionnaire was translated into French by an English teacher and translated back again to English by another teacher. For the validity of the observational data, the observer did not interfere in the consultation or ask question related to the points in the checklist.

3.1. Validity

The validity focuses on whether a test actually succeeds in testing the competencies that is designed to test (42).

To test the external validity of the study a pre-study was done with five practitioners eligible for the study (three healers and two herbalists). During the pilot study the respondents were asked about the suitability of some questions and whether the alternative responses were suitable or not for them. The healers and herbalists included for the pilot study were also excluded for the real study to avoid biases. The checklist was not tested during the pilot study.

To check the internal validity, the questionnaire was translated in French by a teacher and translated back into English by another one. The interviews were done in Bambara, our national language. The questionnaire was translated into French and asked in Bambara because this language is not completed written language. Asking the questions in Bambara while written in French may lead to the loss of some information. However many research studies conducted in Mali had used this same technique. This means the questionnaires will be written in French and the questions asked in Bambara. To minimize the loss of information, we (local supervisor, researcher assistant and main researcher) agreed on the meaning of the questions in Bambara.

The use of observation before the questionnaire interview also limited the phenomenon of contamination that could have occurred during the observation. The practitioners were not aware of the points being observed.

The use of two methods, structured quantitative interviews and non-participant observation could also increase the validity of the data.

3.2. Reliability

The reliability is a measure of the reproducibility or consistency of a test, and is affected by many factors such as examiner judgment and test condition (42). The reliability of the study can be increased by testing the questionnaires during a pilot study and also by using two interviewers. This is what we did for our study. The use of two interviewers may, on the other hand, lead to some variability of the information collected notably from the open questions. This problem was solved during the training session by telling my assistant to report exactly what the respondent has said. After the pilot study we (the local supervisor of the study, the researcher assistant and the main researcher) agreed on some translations in Bambara of the questionnaire and adopted the same ways of noting down the answers.

To make reliable the observational data the main researcher alone did the observation. Also the checklist contained only a single point to be checked at ones.

3.3. Representiveness

To be able to generalize the results of the study to the study population, the sample should be representative of the practitioners (healers and herbalists) registered by the DMT and operating in Bamako. Those practitioners cannot be representative of all healers and herbalists in Mali. Another thing is that the healers and herbalists registered by the DMT may not be representative of those operating in Bamako because many healers and herbalists are operating without being registered by the DMT. However the result of this study could be generalized to some extent to the healers and herbalists registered by the DMT and operating in Bamako. The representativeness of the sample and the sampling technique will be discussed later.

4- Data analysis

Chi-square, Mann Whitney and the Kruskall-Wallis tests depending of the number of groups were used for the statistical analysis. The significant level was set at $p<=0,05$. The

non-parametric methods were used to identify the statistical difference in the level of knowledge of herb-herb and herb-drug interactions according to some independent variables. The study being a descriptive study therefore these methods were suitable for the study. No statistic was calculated for the observational data. Those data were analyzed by cross-analysis of the points observed on the checklist with the answers given during the interviews

5. Ethical consideration

Before starting the data collection all the participants were asked individually about their consent. An official letter from the head of the DMT was sent to the representatives of the associations of healers and herbalist's. The letter was requesting their participation and stated the overall aim of the study. Then we went to meet with the healers and herbalists individually to ask them to join the study. All of them were informed that participation in the study was voluntary and in addition they were free to quit at any time. For the observation the healers and herbalists were not aware of what I was observing. To get their consent I explained to them that the study was about the improvement of their work, in the sense of the collaboration between traditional medicine and modern medicine.

Chapter 4. RESULTS

Four main parts compose this section: results of the pilot study, description of the main characteristics of the study sample, knowledge about interactions and practice about interactions.

Part 1. *Pilot study*

The pilot study was conducted with three healers and two herbalists. After the pilot study, the questionnaire had some modifications mainly on:

- Types of medicines used: The presentation of the herbs (powder, tisane, extracts, and capsules) was replaced by the mode of preparation (decoction, maceration, and fumigation). We added to the mode of use also the local application: bath.
- Advices to patients before given herbs: here we added as alternative answer "moral counseling of the patients".
- Advices to patients taking oral drug when giving them laxative herbs: we added, "Take them together if the drug is antidiarrhoeal" and "mode of use of the plant".

Part 2. Characteristics of the study sample

A total of 48 interviews were validated for the analysis. The healers and herbalists were between 28 and 80 years old with a mean age of 50.39±11.77 years. 56 % (27/48) were males. The majority of the practitioners were herbalists 54 % (26/48). 63% (30/48) of the respondents had inherited background of the practice of traditional medicine. Only 23% (11/48) of the respondents had been to formal school. Out of the 11, 27% (3/11) had studied more than 12 years, 27% (3/11) had reached secondary school (10-12 years), 36 % (4/11) had studied between 7-9 years (junior secondary school) and one had studied between 1-6 years (primary school). Five associations of healers and herbalists were represented in the sample: Association des herboristes de Dibida for 20, Keneya Yiriwaton for nine, Diama Djigui for 11, Bekeneyaton for three and Association N'ko des Thérapeutes Traditionnels for four. There was one who did not state the association to which he belonged.

The majority of the respondents 82% (39/45) had been trained for more than 5 years in their work. 81% (39/48) had worked for more than 5 years, 15% (7/48) had been performing their work between two and five years and only 4% (2/48) had been performing for one year or less. 52% (25/48) of the sample had attended a workshop on the collaboration between traditional medicine and modern biomedicine. Out of these 25, eight had attended workshop on herb-herb interaction and five had attended workshop on herb-drug interaction. 23% (11/48) of the respondents had an alphabetization course in Bambara language. Out of these 11, nine could read and write and two could not read and write Bambara language.

Part 3. Knowledge about interactions

Two parts will compose this section: knowledge of herb-herb interactions and knowledge of herb-drug interactions. The knowledge of herb-herb and herb-drug interactions was examined by using data from the questionnaire (annex1).

I. Knowledge about herb-herb interactions

1. Awareness about herb-herb interactions

We examined the awareness by asking the following question: ”Can an herb interact with another when both are taken together?” Practitioners who answered yes to the question were considered aware and those who answered no or don’t know were considered unaware. 100% (48/48) of the practitioners answered yes when asked can an herb interact with another when both are taken together. We can conclude that all of the practitioners in our sample were aware of herb-herb interactions.

2. Effects reported as results of the interactions between two herbs

The practitioners who answered yes to the above were asked to give the results that can occur when two herbs are taken together. All the practitioners answered to that question. The practitioners reported seven effects that can result from interactions between different herbs. The effects reported are shown in table1.

Table 1. Knowledge of the effects resulting from interactions between different herbs.

Results that can occur from the interaction between different herbs	Number	%
The effects of both herbs can be increased	38	79
One herb can increase the effects of another	17	35
One herb can cancel the effects of another	5	10
One herb can increase the side effects of another	6	13
One herb can decrease the effects of another	5	10
To broaden the therapeutic indication of the association	5	10
The effects of both herbs can be decreased	4	8
Don’t know	1	2

The majority of the practitioners reported beneficial effects of the herb-herb interactions. 79% (38/48) of the practitioners reported, “The effects of both herbs can be increased”

while 35% (17/48) reported, “One herb can increase the effects of another”. Only one practitioner reported not knowing the effect that could result from an interaction between two herbs.

To broaden the therapeutic indication means that the association between the two herbs will produce an activity different from the activity of the herbs taken individually.

3- Herbs that can interact and the effects resulting from that interactions

The practitioners who answered yes to the question “Can an herb interact with another herb when both are taken together”, were asked if they could give example of interacting herbs and also the effects that can occur. 45 practitioners gave examples and three practitioners who did not give examples of herbs; instead gave the name of Improved Traditional Medicines (ITMs). 45 practitioners reported 32 different herbs. Table 3 gives the six most frequent herb-herb combinations reported by at least two practitioners and their effects.

Table 3. Most frequent herbs that can interact and effects resulting from that.

Herb1	Herb2	Effects	Freq.	%
Trichilia emetica Vahl. (Meliaceae)	*Anogeissus leiocarpa*	Effects of both are increased	4	9
Nauclea latifolia Sm. (Rubiacea)	*Mitragyna inermis* (Willd) O.Kttze (Rubiaceae)	Effects of both are increased	4	9
Anogeissus leiocarpa (DC.) Guill. et Perrott. (Combretaceae)	*Mitragyna inermis*	Association increases recovery	4	9
Cassia sieberiana DC. (Ceasalpiniaceae)	*Nauclea latifolia*	Association increases recovery	3	7
Vernonia kotschiana Sch.Bip (Asteraceae)	*Cochlospermum tinctorium* Perr. (Cochlospermaceae)	Complementary effects	2	4
Ximenia americana L. (Olacaceae)	*Fagara xantoxyloides* Lam. (Rutaceae)	Complementary effects	2	4

Trichilia emetica with *Anogeissus leiocarpa* (4/48), *Nauclea latifolia* with *Mitragyna inermis* (4/48) and *Anogeissus leiocarpa* with *Mitragyna inermis* (4/48) were the most frequently reported herbs that can interact. The effects that may result from those interactions are: effects of both herbs are increased and the association increases recovery of the patients.

4. Agreement on some statements on herb-herb interactions

The practitioners were asked about their agreement on some statements related to herb-herb interactions (section E annex1). Two practitioners did not give their opinion one the statement, which leads to response of 96% (46/48). Table 4 gives the degree of agreement of the practitioners on the statements.

Table 4. Degree of agreement about some statements on herb-herb interactions.

Statement	Degree of agreement										Total	
	Strongly agree		Agree		Disagree		Strongly disagree		No idea			
	N	%	N	%	N	%	N	%	N	%	N	%
There is always increase of effects of both herbs	20	43	22	48	0	0	0	0	4	9	46	100
The effects of both herbs can be increased	20	43	22	48	0	0	0	0	4	9	46	100
The effects of both herbs can be decreased	1	2	23	50	7	15	7	15	8	18	46	100
The side effects of one of the herbs can be alleviated	14	31	24	32	1	2	1	2	8	17	46	100

A great majority 91% (43% and 48%) of the practitioner shares the opinion that the effects of both herbs always increase or can increase. 63% (31% and 32%) of the practitioners shares the opinion that the side effects of one herb can be alleviated.

5. Level of knowledge of herb-herb interactions

The practitioners were scored according to the answers they gave concerning the questions about the effects that can occur when two herbs are taken together in order to determine their level of knowledge. Three categories have been used to categorize the level of knowledge of the respondents about herb-herb interaction (see scoring of variables in method p.33). Table 5 gives the level of knowledge of the practitioners of herb-drug interaction.

Table 5. Level of knowledge of the practitioners of herb-herb interactions.

Level of knowledge	Number	%
Low	33	69
Moderate	11	23
High	4	8
Total	48	100

The majority of the practitioners 69% (33/48) were categorized with low level of knowledge of herb-herb interactions.

5.1. The level of knowledge of herb-herb interactions according to the profession

The practitioners were asked to state the profession they considered themselves to belong to. The practitioners belonged to two different professions: healers and herbalists. Table 6 shows the level of knowledge of herb-herb interactions according to the profession.

Table 6. Level of knowledge of herb-herb interactions according to profession.

Level of knowledge	Profession				Total	
	Healers		Herbalists			
	N	%	N	%	N	%
Low	11	50	22	85	33	69
Moderate	7	32	4	15	11	23
High	4	18	0	0	4	8
Total	22	100	26	100	48	100

Half of the healers (11/22) and 85% (22/26) of the herbalists were categorized with low level of knowledge of herb-herb interactions. At the same time no herbalist was categorized with high level of knowledge while four healers did. The difference was statistically significant (X^2= 8,209 df= 2 p=0,017). Then we reject the null hypothesis and conclude that there is a statistically significant difference between healers and herbalists in the level of knowledge of herb-herb interactions.

5.2. The level of knowledge of herb-herb interactions according to gender

Table 6 shows level of knowledge of herb-herb interactions according to the gender of the practitioners.

Table 6. Level of knowledge of herb-herb interaction according to gender.

Level of knowledge	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Low	14	52	19	90	33	69
Moderate	9	33	2	10	11	23
High	4	15	0	0	4	8
Total	27	100	21	100	48	100

52% (14/27) of the male practitioners and 90% (19/21) of the female practitioners were categorized with low level of knowledge of herb-herb interactions. 15% (4/27) of the male practitioners were categorized with high level of knowledge while no female was categorized with high level of knowledge. The difference was statistically significant (X^2=8,596, df =2, p=0,014). We reject the null hypothesis and conclude that there is a significant difference between male practitioners and female practitioners in the level of knowledge of herb-herb interactions.

5.3. The level of knowledge of herb-herb interactions according to age

Two age groups were used for the analysis of the level of knowledge of herb-herb interaction according to age: 28-50 years (group 1) and 51-80 years (group 2). Table 7 gives the level of knowledge of the respondents of herb-herb interactions according to age.

Table 7. Level of knowledge of herb-herb interactions according to age groups.

Level of knowledge	Age groups				Total	
	28-50 years		51-80 years			
	N	%	N	%	N	%
Low	14	61	19	76	33	69
Moderate	6	26	5	20	11	23
High	3	13	1	4	4	8
Total	23	100	25	100	48	100

61% (14/23) of the practitioners of 50 years old or less and 76% (19/25) of those above 50 years old were categorized with low knowledge. The difference was not statistically significant (p=0,22). We accept the null hypothesis and conclude that there is no significant difference in the level of knowledge of herb-herb interactions between practitioners 50 years old or less and above 50 years.

5.4. The level of knowledge of herb-herb interactions according to the background of the practitioners (inherited and not inherited)

The practitioners were asked in the questionnaire whether they had inherited or not the practice of traditional medicine. The practitioners were categorized according to their background as inherited or non-inherited. 62% (30/48) of the practitioners were with inherited background of the practice of traditional medicine. Table 8 shows level of knowledge according to the background of the respondents.

Table 8. Level of knowledge of herb-herb interactions according to background.

Level of knowledge	Background				Total	
	Inherited		Non-inherited			
	N	%	N	%	N	%
Low	17	57	16	89	33	69
Moderate	10	33	1	5	11	23
High	3	10	1	5	4	8
Total	30	100	18	99	48	100

57% (17/30) of practitioners with inherited background and 89% (16/18) of those with non-inherited background were categorized with low knowledge of herb-herb interactions. The difference was statistically significant by Mann Whitney and Gamma tests (p=0,03). We reject the null hypothesis and conclude that there is a significant difference in the level of knowledge of herb-herb interaction between practitioners with inherited background and those with not inherited background.

5.5. The level of knowledge of herb-herb interactions according to formal schooling

The respondents were asked during the questionnaire for how many years they have been to formal school. The responses were categorized, as following: never, 1-6 years, 7-9 years, 10-12 years and more than 12 years. Only 11 respondents had been to formal school. For the analysis the respondents were classified as “school yes” or “school no”. Table 9 shows the level of knowledge according to formal schooling.

Table 9. Level of knowledge of herb-herb interactions according to formal schooling.

Level of knowledge	Formal schooling				Total	
	Yes		No			
	N	%	N	%	N	%
Low	4	36	29	78	33	69
Moderate	3	27	8	22	11	23
High	4	36	0	0	4	8
Total	11	100	37	100	48	100

Four out of 11 respondents with formal schooling and 78%(29/37) of those with no formal school were categorized with low knowledge. On the other hand no one among those with no formal schooling had high knowledge while four out of 11 with formal school had high level of knowledge. The difference was statistically significant (X^2= 15,75 df =2 p<0,001). We reject the null hypothesis and conclude that there is a significant difference in the level of knowledge between practitioners with formal schooling and those with formal schooling.

5.6. The level of knowledge of herb-herb interactions according to the alphabetization in Bambara

The respondents were asked if they have attended any alphabetization in Bambara. 11 out of the 48 had attended alphabetization course in Bambara. Table 10 gives the level of knowledge according to the alphabetization.

Table 10. Level of knowledge of herb-herb interactions according to the alphabetization.

Level of knowledge	Alphabetization				Total	
	Yes		No			
	N	%	N	%	N	%
Low	4	36	29	78	33	69
Moderate	3	27	8	22	11	23
High	4	36	0	0	4	8
Total	11	100	37	100	48	100

Four out of 11 respondents who had alphabetization in Bambara and 78%(29/37) of those with no alphabetization were categorized with low knowledge. On the other hand no one among those with no alphabetization had high knowledge while four out of 11 with alphabetization had high level of knowledge. The difference was statistically significant (X^2= 15,75 df =2 p<0,001). We reject the null hypothesis and conclude that there is a significant difference between practitioners who had alphabetization in Bambara and those who had not.

5.7. The level of knowledge of herb-herb interactions according to the length of time in work (experience)

The respondents were asked for how long time they have been performing their work as traditional practitioner. The majority of the respondents 82% (39/48) had been performing their work more than five years. For the analysis the respondents were divided in two groups: group 1 for respondents with five years or less in work and group

2 for those with more than five years. Table 11 gives the level of knowledge of herb-herb interaction according to length in time of work.

Table 11. Level of knowledge according to length of time in work.

Level of knowledge	Length of time in work				Total	
	5 years or less		More than 5 years			
	N	%	N	%	N	%
Low	7	78	26	67	33	69
Moderate	2	22	9	23	11	23
High	0	0	4	10	4	8
Total	9	100	39	100	48	100

Seven out of nine respondents who had worked five years or less and 67% (26/39) of those who had worked more than five years were categorized with low level of knowledge. The difference was not statistically significant (X^2=1.05, df=2 p= 0,59). The low number of the sample size may limit our conclusion.

5.8. The level of knowledge of herb-herb interactions according to the attendance to a workshop on collaboration between traditional medicine and modern biomedicine

The respondents were asked if they have attended any workshop on the collaboration between traditional medicine and modern biomedicine. Also they were asked to state the topics discussed during that workshop. Table 12 gives the level of knowledge according to the attendance to a workshop.

Table 12. Level of knowledge of herb-herb interactions according to the attendance to a workshop on the collaboration between traditional medicine and modern biomedicine.

Level of knowledge	Attendance to a workshop on the collaboration between traditional medicine and modern biomedicine				Total	
	Yes		No			
	N	%	N	%	N	%
Low	12	48	21	91	33	69
Moderate	9	36	2	9	11	23
High	4	16	0	0	4	8
Total	25	100	23	100	48	100

48% (12/25) of the respondents who had attended a workshop on the collaboration between the two types of medicines and 91% (21/23) of those who did not attend were categorized with low knowledge of herb-herb interactions. All respondents with high level of knowledge of herb-herb interactions had attended workshop. The difference was statistically significant (X^2 =10,84, df=2 and p=0,004). We reject the null hypothesis and

conclude that there is a significant difference in the level of knowledge between practitioners who attended a workshop on the collaboration between traditional medicine and modern biomedicine and those who did not.

Since the difference was found significant we looked for the other aspects of the workshop: time of attendance and the topics discussed during the workshop (production of Improved Traditional Medicines and herb-herb interactions). The time of attendance was as follows: once, twice, 3-5 times and more 5 times. No significant difference was found with the Kruskall-Wallis test in the times of attendance (N= 15, p=0,240). No difference was found also in the ITM production (N=16, p=0,33). The difference was also not significant in the herb-herb interactions (N=8, p=0,9). The low number of the sample in each group may be the cause for not seeing any difference.

6. Practitioner's perception on their own knowledge of herb-herb interactions

The practitioners were asked to rate their own level of knowledge about herb-herb interaction. The majority of the practitioners 56% (27/48) considered themselves having moderate level of knowledge of herb-herb interaction, while 31% (15/48) considered themselves having high knowledge and only 13% (6/48) considered themselves having low level of knowledge of herb-herb interaction.

7. Practitioner's willingness to improve their knowledge of herb-herb interactions

The practitioners were asked to tell us whether the knowledge they had was sufficient or not and also to say if they felt the need to improve their knowledge about herb-herb interactions. Those who felt the need to improve their knowledge were asked to give the ways they preferred to meet their needs.

71% (34/48) of the interviewed thought they did not have sufficient knowledge of herb-herb interactions, whereas 25% (12/48) said they had sufficient knowledge.

98% (47/48) said they felt the need to have more knowledge about herb-herb interaction. Only one practitioner said he did not need more knowledge about herb-herb interaction because of his very old age.

The ways the practitioners preferred for improving their knowledge of herb-herb interactions are reported in table 13.

Table 13. Ways preferred by the practitioners to improve their knowledge of herb-herb interactions.

Ways preferred	N	%
1st choice: Exchange of experience among practitioners	40	83
2nd choice: Organization of workshops	28	58
3rd choice: Campaign of sensitization about herb-herb interaction on radio or TV	25	52

83% (40/47) of the respondents had opted for exchange of experience among practitioners as 1st choice to improve their level of knowledge of herb-herb interactions.

8. Sources of knowledge of herb-herb interactions

The practitioners were asked about the sources from where they have obtained knowledge of herb-herb interactions. The practitioners, who said that their knowledge comes from workshops, were asked to specify who organized those workshops. The sources of knowledge of herb-herb interactions are given in the table 14.

Table 14. Sources of knowledge about herb-herb interactions.

Sources of knowledge about herb-herb interactions	Number	%
Own experience	21	44
Parents	16	33
Courses/workshops	5	10
Colleagues	5	10
Literature	1	2
Total	48	100

44% (21/48) of the practitioners said they had knowledge of herb-herb interactions from their own experience and from their parents for 33% (16/48). For the five respondents who had knowledge through workshops, four said healers and herbalists associations organized the workshops they have attended and one said the Department of Traditional Medicine organized the workshop he attended.

II. Knowledge about herb-drug interactions

1. Awareness about herb-drug interactions

The awareness of the practitioners about herb-drug interactions was determined by asking the following question ”Can an herb interact with a conventional drug when both are taken together?” The practitioners who answered yes were considered as aware and those who answered don’t know or no were considered unaware about herb-drug interactions. 58% (28/48) of the respondents answered yes to the question, 19% (9/48) answered no and 23% (11/48) answered don’t know. From that we conclude that 58% of the practitioners are aware of herb-drug interactions.

2. Effects reported as results of herb-conventional drug interactions

The practitioners who answered yes to the question on awareness were asked to give the effects that may occur when herb and conventional drug are taken together. Out of the 28 practitioners who answered yes, 23 reported eight effects that may occur when herb and conventional drug are taken together and five said they did not know the results that might occur when herb and drug are taken together. Table 15 gives the effects that may occur when herb and drug are taken together.

Table 15. Knowledge on the effects that may occur when herb and drug are taken together.

Effects that may occur when herb and drug are taken together	Number	%
The effects of both herb and drug can be increased	15	56
The effects of one can be increased by the other	8	30
The side effects of both herb and drug can be increased	4	15
The effects of one can be cancelled by the other	3	11
The effects of both herb and drug can be cancelled	2	7
The herb and the drug have complementary effects	2	7
The effects of one can be decreased by the other	1	4
The effects of both herb and drug can be decreased	1	4
Don’t know	5	18

The majority 86% (56% and 30%) of the respondents reported beneficial effects of herb-drug interaction. 56% (15/23) said the effects of the herb and the drug can be increased

when both are taken together. The effects of one can be increased by the other was reported by 30% (8/23) of the respondents.

3. Most frequent herbs and conventional drugs that can interact

The practitioners who answered that an herb can interact with a conventional drug were asked to give examples of herbs and drugs that can interact. Out the 28 who said that an herb could interact with a conventional drug, 22 (76%) gave examples of herbs and drugs that can interact. Table 16 gives the most frequent herbs and drugs that can interact.

Table 16. Herbs and conventional drugs that can interact.

Herbs	Groups of Drugs	Number	%
Mitragyna inermis	Antimalarial	6	27
Nauclea latifolia	Antimalarial	2	9
Sclerocarya birroea (A.Rich.) Hochst. (Anacardiaceae)	Heart medicines	2	9
Guiera senegalensis Lam. (Combretaceae)	Antimalarial	1	4
”	Antifungal	1	4
”	Antibiotic (amoxicillin)	1	4
Securinega virosa (Roxb. Ex Willd.) (Euphorbiaceae)	Antispasmodic	1	4
Combretum micranthum G.Don (Combretaceae)	Antibiotic (ampicillin)	1	4
Cassia sieberiana DC (Cesalpinaceae)	Antimalarial	1	4
”	Any drug	1	4
Sterculia setigera Del. (Sterculiaceae)	Antimalarial (chloroquine)	1	4
”	Pain killers	1	4
Cassia alata (Cesalpiniaceae)	Any drug	1	4
Hymenocardia acida Tul. (Euphorbiaceae)	Antimalarial	1	4
Cassia italica (Mill.) Lam (Cesalpiniaceae)	Antiulcer	1	4
Burkea africana Hook (Cesalpiniaceae)	Antifungal	1	4
Stylosanthes mucronata Willd. (Fabaceae)	Antimalarial	1	4
”	Any drug	1	4
Ficus capensis Thunb. (Moraceae)	Antispasmodic	1	4
Vernonia kotschiana	Antiulcer	1	4
“	Any drug	1	4
“	Pain killers	1	4
Entada africana Guill.&Perr. (Mimosaceae)	Heart medicines	1	4
Malarial (3 plants, DMT ITM)	Antimalarial (Quinines)	1	4

The practitioners reported that interactions might occur between many herbs and some groups of conventional drugs. As shown in table 16, *Mitragyna inermis* and antimalarial drugs were the most frequent herb and drug that they meant could interact.

4. Agreement on some statements on herb-drug interactions

The practitioners were asked about their agreement on some statements related to herb-drug interactions (section E annex 1). The response rate was 85% (43/48). Table 17 gives the degree of agreement on those statements.

Table 17. Degree of agreement on some statements on herb-drug interactions.

Statement	Degree of agreement										Total	
	Strongly agree		Agree		Disagree		Strongly disagree		No idea			
	N	%	N	%	N	%	N	%	N	%	N	%
There is always an increase of effects of the herb by the conventional drug	2	5	16	37	2	5	0	0	23	53	43	100
The effects of herb and drug can be increased	5	12	18	42	0	0	0	0	20	46	43	100
The effects of the herb and drug can be reduced	0	0	15	35	6	14	3	7	19	44	43	100
The side effects of the conventional drug can be alleviated by the herb	0	0	15	35	5	12	1	2	22	51	43	100

Half of the respondents 53% (23/43) said they had no idea about the statement that there is always an increase of the effects of the herb by the drug while 42% (37% and 5%) shared that statement. On the other hand 54 % (42% and 12%) of the practitioners shared the statement that the effects of the herb and the drug can be increased when both are taken together.

5. Level of knowledge of herb-drug interactions

The practitioners were scored according to the answers they gave concerning the questions about the effects that may occur when herb and drug are taken together in order to determine their level of knowledge. Three categories have been used to categorize the level of knowledge of the practitioners about herb-conventional drug interactions (see

definition of variables in method p.33). Table 18 gives the level of knowledge of the practitioners about herb-drug interactions.

Table18. Level of knowledge of herb-conventional drug interactions.

Level of knowledge	Number	%
Low	40	83
Moderate	7	15
High	1	2
Total	48	100

The great majority of the practitioners 83% (40/48) were categorized with low level of knowledge of herb-drug interactions.

5.1. The level of knowledge of herb-drug interactions according to profession

Table19 shows the level of knowledge of herb-drug interactions according to profession.

Table19. Level of knowledge of herb-drug interactions according to profession.

Level of knowledge	Profession				Total	
	Healers		Herbalists			
	N	%	N	%	N	%
Low	16	72	24	92	40	83
Moderate	5	23	2	8	7	15
High	1	4	0	0	1	2
Total	22	100	26	100	48	100

72% (16/22) of healers and 92% (24/26) of the herbalists were categorized with low level of knowledge of herb-drug interactions. The difference was not statistically significant (X^2=3,57, df=2 and p=0,17). Then we accept the null hypothesis and conclude that the observed difference is statistically significant.

5.2. The level of knowledge of herb-drug interactions according to gender

Table 20 gives the level of knowledge of herb-drug interactions according to gender.

Table 20. Level of knowledge of herb-drug interactions according to gender.

Level of knowledge	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Low	19	70	21	100	40	83
Moderate	7	26	0	0	7	15
High	1	4	0	0	1	2
Total	27	100	21	100	48	100

100% (21/21) of the female practitioners and also a big majority of the male practitioners 70% (19/27) were categorized with low level of knowledge of herb-drug interactions. The difference was statistically significant (X^2=7,46 df=2 and p=0,024). We reject the null hypothesis and conclude that there is a significant difference in the level of knowledge of herb-drug interactions between male and female practitioners.

5.3. The level of knowledge of herb-drug interactions according to age

Table 21 gives the level of knowledge of herb-drug interactions according to age.

Table 21. Level of knowledge of herb-drug interactions according to the age.

Level of knowledge	Age group				Total	
	28-50 years		51-80 years			
	N	%	N	%	N	%
Low	15	65	25	100	40	83
Moderate	7	30	0	0	7	15
High	1	4	0	0	1	2
Total	23	100	25	100	48	100

65%(15/23) of the practitioners of 50 years old or less and 100% (25/25) of those above 50 years old were categorized with low level knowledge of herb-drug interaction. The difference was statistically significant (X^2=10,54 df=2 p=0,005). We reject the null hypothesis and conclude that there is a significant difference in the level of knowledge of herb-drug interactions between practitioners of 50 years old or less and those of more than 50 years old.

5.4. The level of knowledge of herb-drug interactions according to the background (inherited or non-inherited)

Table 22 gives the level of knowledge of herb-drug interactions according to the background of the practitioners.

Table 22. Level of knowledge of herb-drug interactions according to background.

Level of knowledge	Background				Total	
	Inherited		Non-inherited			
	N	%	N	%	N	%
Low	23	77	17	94	40	83
Moderate	6	20	1	6	7	15
High	1	3	0	0	1	2
Total	30	100	18	100	48	100

77% (23/30) of the inherited practitioners and 94% (17/18) of the non-inherited practitioners had low knowledge. The difference was not statistically significant (X^2=2,636 df=2 p=0,27). We accept the null hypothesis and conclude that the observed difference is not statistically significant. The low number of the sample could probably explain why the difference was not significant.

5.5. The level of knowledge of herb-drug interactions according to formal schooling

Table 23 shows the level of knowledge according to formal schooling.

Table 23. Level of knowledge of herb-drug interactions according to formal schooling (yes or no).

Level of knowledge	Formal schooling				Total	
	Yes		No			
	N	%	N	%	N	%
Low	9	82	31	84	40	83
Moderate	1	9	6	16	7	15
High	1	9	0	0	1	2
Total	11	100	37	100	48	100

Nine out of the 11 practitioners who had formal schooling and 84% (31/37) of those who had no formal school were categorized with low level of knowledge. The difference was not significant (X^2=3,663 df=2 p=0,16). We accept the null hypothesis and conclude that the observed difference is not statistically significant.

In addition, the practitioners were also asked about their alphabetization in Bambara language. There was no significant difference in the level of knowledge of herb-drug interactions between the practitioners who had alphabetization and those who did not p=0,24.

5.6. The level of knowledge of herb-drug interactions according to the length of time in work (experience)

Table 24 gives the level of knowledge of herb-drug interactions according to the length of time in work.

Table 24. Level of knowledge about herb-drug interactions according to the length of time in work.

Level of knowledge	Length of time in work				Total	
	5 years or less		More than 5 years			
	N	%	N	%	N	%
Low	6	67	34	87	40	83
Moderate	3	33	4	10	7	15
High	0	0	1	3	1	2
Total	9	100	39	100	48	100

Six out of the nine practitioners with 5 years or less in work and 87% (34/39) of those with more 5 years in work were categorized with low level of knowledge of herb-drug interactions. The difference was not statistically significant between the two groups (X^2=3,270 df=2 p=0,195). We accept the null hypothesis and conclude that the observed difference is not statistically significant. The low number of the sample could probably explain why the difference is not significant.

5.7. The level of knowledge of herb-drug interactions according to the attendance to a workshop on collaboration between traditional medicine and modern biomedicine

Table 25 gives the level of knowledge of herb-drug interactions according to the attendance to a workshop on the collaboration between the traditional medicine and the modern biomedicine.

Table 25. Level of knowledge of herb-drug interactions according to the attendance to a workshop on the collaboration between traditional medicine and modern biomedicine.

Level of knowledge	Attendance to a workshop on the collaboration between traditional medicine and modern biomedicine				Total	
	Yes		No			
	N	%	N	%	N	%
Low	19	76	21	91	40	83
Moderate	5	20	2	9	7	15
High	1	4	0	0	1	2
Total	25	100	23	100	48	100

19 out of the 25 practitioners who had attended workshop and 21 out of 23 of those who did not attend workshop were categorized with low knowledge of herb-drug interactions. The difference was not statistically significant (X^2=2,306 df=2 p=0,32). We accept the null hypothesis and conclude that the observed difference is not statistically significant. The low number of the sample size can however limit the conclusion.

6. Practitioner's perception on their own knowledge of herb-drug interactions

The practitioners were asked to rate their own level of knowledge of herb-drug interactions. Two practitioners did not answer to the question that leads to a response rate of 96% (46/48). 52% (24/46) of the practitioners considered that they had low level of knowledge, 26% (12/46) said that they did know their level of knowledge and 22% (10/48) considered that hey had moderate level of knowledge of herb-drug interactions. As we see no respondent had considered himself with high level of knowledge of herb-drug interactions.

7. Practitioner's willingness to improve their knowledge of herb-drug interactions

The practitioners were asked to tell us if their level of knowledge of herb-drug interactions was sufficient or not and also to say if they felt the need to improve their knowledge about herb-drug interactions. The practitioners who felt the need to improve their knowledge were asked to specify the ways they preferred for improving their knowledge.

71% (34/48) of the practitioners said they had not sufficient knowledge and 15% (7/48) said they didn't know their level of knowledge, whereas 15% (7/48) of the practitioners thought they had sufficient knowledge of herb-drug interactions. On the other hand, 86% (42/48) of the practitioners said they felt the need to have more knowledge of herb-drug interactions. Only 14% (6/48) of the practitioners said they did not want to have more knowledge of herb-drug interactions. The practitioners, who said they did not want to have more knowledge, advanced three reasons: three practitioners said because they have not been to school, one practitioner said he had never told his patients to use conventional drug with herb and one practitioner said because the knowledge he had was sufficient. For the practitioners who wanted more knowledge of herb-drug interactions (n=42), the ways they preferred are given in table 26.

Table 26. Ways preferred to improve their knowledge of herb-conventional drug interactions.

Ways preferred	Number	%
1st choice: Organization of workshops	29	60
2nd choice: Exchange of experience among practitioners	25	52
3rd choice: Production of hand books in Bambara	18	38

60% (29/48) of the respondents said they preferred to have organization of workshops on herb-drug interactions as 1st choice to improve their knowledge of herb-drug interactions.

8. Sources of knowledge of herb-drug interactions

The practitioners were asked to give the sources from where they have obtained knowledge of herb-drug interactions. The practitioners who said they had knowledge from workshops were asked to specify who organized those workshops. Table 27 gives the main sources of knowledge of herb-drug interactions.

Table 27. Sources of knowledge of herb-drug interactions.

Sources of knowledge about herb-drug interaction	Number	%
Own experience	22	73
Colleagues	3	10
Parents	3	10
Courses or workshops	1	3
Literature	1	3
Total	30	100

The majority of the practitioners 73% (22/30) said they had knowledge of herb-drug interactions through their own experience. Only one practitioner said he had knowledge through workshop organized by healers' association.

Part 4. Practice

Two tools, a semi-structured questionnaire and a checklist, were used to gather data about the practice on herb-herb and herb-conventional drug interactions. First I shall present the results on practice from the questionnaire and later the results from the checklist will be presented.

I. Practice from questionnaire (annex 1)

Two parts will compose this section: practice about herb-herb interactions and practice about herb-drug interactions.

A. Practice about herb-herb interactions

In this part I shall present the results on the types of medicines used, the most frequent herbs used, the most frequent herb-herb combinations that practitioners experienced interactions with, the herbs that can interact when both are taken together, the herbs that should never be used together.

1. Categories of medicines used

The practitioners were asked to tell which categories of medicines they used. The practitioners used four categories of medicines. Table 28 gives the categories of medicines used by the practitioners.

Table 28. Categories of medicines used.

Categories of Medicines used	N	%
Herbs	48	100
Improved Traditional Medicines (ITMs)	11	23
Mineral elements	6	12
Animal products	3	6

All the practitioners (48/48) were using herbs and 23% (11/48) of them were also using Improved Traditional Medicines (ITMs).

2. Herbs most frequently used

The practitioners were asked if they could give the names of three herbs that they used most frequently. Two practitioners answered no and five did not give the names of herbs

but gave instead the name of a combination of herbs. The answers of those were not taken into account in these frequencies. 46 respondents, who answered yes, 41 reported 48 different herbs as the three most frequently used herbs. Among those herbs, 29 were mentioned only once and nine mentioned twice. Ten herbs were mentioned more than twice. Table 29 gives the then herbs most frequently used by the practitioners.

Table 29. Ten herbs most frequently used by traditional practitioners.

Herbs	Number	%
Mitragyna inermis	15	32
Trichilia emetica	13	28
Cassia sieberiana	11	24
Anogeissus leiocarpa	10	22
Nauclea latifolia	9	20
Entada africana	8	17
Ximenia americana	7	15
Opilia celtidifolia	5	11
Ficus heterofila	4	9
Fagara xantoxyloides	3	7

Mitragyna inermis (15/46), *Trichilia emetica* (13/46) and *Cassia sieberiana* (11/46) were the three most frequent herbs that the practitioners were using.

3. Frequency at which practitioners have experienced interactions between different herbs

The practitioners were asked if in their practice they had experienced any effects that result from interactions between different herbs. Those who had experienced interactions were asked to specify the frequency at which they had experienced it. The response rate was 98% (47/48) because one practitioner did not answer to that question.

94% (44/47) of the practitioners said they have experienced interactions between two herbs and 6% (3/47) said they don't know. 55% (24/44) of the practitioners who had experienced herb-herb interactions, said they had experienced it once a week while 30% (13/44) said every day. Table 30 gives the frequency of herb-herb interactions according to the level of knowledge about herb-herb interactions.

Table 30. The frequency of herb-herb interactions according to the level of knowledge of herb-herb interactions.

Level of knowledge	The frequency of herb-herb interaction					Total
	Every day	Once a week	Once a month	Once a year	More seldom than a year	
Low	9	19	2	0	2	32
Moderate	3	5	0	0	2	10
High	1	0	0	1	0	2
Total	13	24	2	1	4	44

19 out of 32 with low knowledge of herb-drug interaction had experienced interaction once a week while nine had experienced it every day. The difference was not statistically significant by the Kruskall-Wallis test (p=0,152). We accept the null hypothesis and conclude that the observed difference is not significant. This finding is may be limited by the lowest size of the numbers in each of the groups.

4. Herb-herb combinations used

The practitioners were asked if they told their patients to take different herbs together. The responses were categorized as: never, sometimes, often and always. The response rate was 96% (46/48), two practitioners did not want to answer that question. 43 of the 46 respondents reported 31 different herbs that they told their patients to take together. All the respondents said they that were telling patients to take different herbs together (46/46). 78% (36/46) said they told their patients to take different herbs together often, while 11% (5/46) said they asked them to do so always. 4% (2/46) said they never told their patients to take different herbs together while 6% said they did sometimes. Table 31 shows the herbs that were reported by more than one practitioner.

Table 31. Herb-herb combinations that practitioners used together.

Herb1	Herb2	Number	%
Mitragyna inermis	*Anogeissus leiocarpa*	4	9
	Nauclea latifolia	3	7
	Trichilia emetica	2	4
Anogeissus leiocarpa	*Trichilia emetica*	2	4

Mitragyna inermis with *Anogeissus leiocarpa* were the two most frequent herb-herb combinations used together by practitioners.

Reasons for taking different herbs together at the same time

The practitioners who were telling their patients to take different herbs together were asked how those herbs were taken. The responses were either at the same or at different times. 95% (42/44) of the respondents said they told patients to take different herbs at the same time while 5% (2/44) said they told the patients to take those herbs at different times. The reasons for taking the different herbs at the same time are given in table 32

Table 32. Reasons for taking different herbs at the same time.

Reasons	Number	%
The two herbs reinforce the effects of each other	37	88
There is no interaction between the herbs	1	2
One of the herbs cannot act without the other	1	2
Help to reduce the dosage of the two herbs*	1	2
Each herb has an effect different from the effects of the association	1	2
Because one herb tasted well and the other not	1	2
Total	42	100

* This effect could be understood as the first but in my sense they are different because drugs may be synergistic but this will not necessarily lead to the reduction of the dosage of one of them. The effect can be interpreted as potentiating effect.

The big majority of the respondents 88% (37/44) said they were telling patients to take different herbs at the same time because the herbs reinforce the effects of each another.

5. Herbs that can never be taken together and the results of the interactions between them

The practitioners were asked if according to their experience and knowledge there were some herbs that can never be taken together. The response rate was 98% (47/48). 32 respondents answered yes, 14 respondents answered don't know and one respondent answered no. Out of the 32 who answered yes, 29 respondents had reported 21 herbs that can never be taken together. Table 33 shows the herbs that can never be taken together and the results of the interactions that may occur.

Table 33. Herbs that can never be taken together and the results of the interactions.

Herb1	Herb2	Results (consequences of the interaction)	Freq.
Swartzia madagascariensis Desv. (Ceasalpiniaceae)	*Securidaca longipedunculata*	Serious/dangerous consequences (profuse diarrhea and vomiting, increased toxicity or even lead to death)	8
"	*Erythrophleum guineense*		2
"	*Gardenia ternifolia* Schum. &Thonn (Rubiaceae)		1 1
"	*Opilia celtidifolia* Endl.ex Walp (Opiliaceae)		1
"	*Nauclea latifolia*		1
Securidaca longipedunculata Fresen. (Polygalaceae)	*Sclerocarya birroea*		1
"	*Cassia italica*		1
Erythrophleum guineense (Ceasalpiniaceae)	Any plant		1
Cassia italica *Securidaca longipedunculata*	*Combretum micranthum* *Afrormosia laxiflora* (Benth.ex Baker) Harms (Fabaceae)	Mild consequences (benign diarrhea, dizziness, headaches, fever)	1 1
Lannea velutina A.Rich. (Anacardiaceae) *Tamarindus indica* *Cassia nigricans* Vahl. (Ceasalpiniaceae)	*Securinega virosa* *Ficus heterofila* (Moraceae) *Bridelia farruginea* Benth. (Euphorbiaceae)	Other (effects of one is canceled by the other)	1 1 1

Three main reasons were reported as results of the interaction between herbs that can never be taken together. Those results were:

- Serious/dangerous consequences (profuse diarrhea and vomiting) or lead to death like with *Swartzia madagascariensis* and *Securidaca longipedunculata*
- One herb can cancel the effects of another: like with *Lannea velutina* and *Securinega virosa.*
- Mild consequences (benign diarrhea, dizziness, headaches, fever) like with *Cassia italica* with *Combretum micranthum*

B. Practice about herb-drug interactions

In this section I shall present the herbs that can never be taken with conventional drugs and the frequency the practitioners had experienced herb-drug interactions.

1. Herbs and conventional drugs that practitioners never use together and the interactions resulting from them

The practitioners were asked if according to their experience and knowledge there were herbs that can never be taken together with conventional drugs and also to report the interactions that may occur. 13 herb-drug combinations were reported as combinations never to be taken together. Table 34 shows the herbs and conventional drugs that can never be taken together.

Table 34. Herbs and conventional drugs that can never be taken together.

Herb	Drugs	Results (consequences) of the interaction	Freq.
Securidaca longipedunculata	Any drug	Serious or dangerous consequences (profuse diarrhea and vomiting, increasing toxicity or even death)	2
Swartzia madagascariensis	Any drug		2
Gardenia ternifolia	Any drug		1
Mitragyna inermis	Any drug		1
Swartzia madagascariensis	Emetic drug		1
Opilia celtidifolia	Any drug		1
Afrormosia laxiflora	Any drug		1
Guiera senegalensis	Pain killer	Mild consequences: (headaches, dizziness, benign diarrhea and vomiting)	1
Gmel (Combretaceae)	Any drug		1
Cassia sieberiana	Antibiotic		1
Securidaca longepedunculata	Pain killer		1
Swartzia madagascariensis	Antimalarial drug		1
Cassia italica			
Cola nitida Shott &Endl (Sterculiaceae)	Any drug	Other (one cancel the effect of the other)	1

Three main results were found as results of the interaction between herbs and drugs that cannot be taken together. Those reasons are:

- The herb can cancel the effect of the drug as with *Cola nitida* when taken with any conventional drug.
- Serious or dangerous consequences (Increasing toxicity, severe diarrhea, death like with *Swartzia madagascariensis* and any drug.

- Mild consequences: (headaches, dizziness, benign diarrhea and vomiting) like with *Cassia italica* and antimalarial drug.

2. Frequency at which practitioners have experienced interactions between herbs and conventional drug

The practitioners were asked if in their practice they had experienced effects that result from interactions between herbs and conventional drugs. Those who had experienced interaction were asked to specify the frequency at which they had experienced it. The response rate was 94% (45/48) because three respondents did not want to answer to that question.

44% (20/45) of the respondents said they had experienced interactions herb-conventional drug, 42% (19/45) said they did not experienced it and 13% (6/45) said they don't know. Out of the 20 respondents, who had experienced herb-drug interactions, eight said they had experienced it once a week, while three said every day. Five respondents said they had experienced interactions once a month while four said more seldom than once a year. Table 35 gives the frequency at which the practitioners had experienced herb-drug interactions according to the level of knowledge of herb-drug interactions.

Table 35. The frequency of herb-drug interaction according to the level of knowledge of herb-drug interactions.

Level of knowledge about herb-drug interaction	The frequency of herb-drug interactions					Total
	Every day	Once a week	Once a month	Once a year	More seldom than a year	
Low	2	6	3	0	2	13
Moderate	1	2	2	0	2	7
High	0	0	0	0	0	0
Total	3	8	5	0	4	20

Six out of 13 respondents with low knowledge of herb-drug interactions had experienced herb-drug interaction once a week. No one of the respondents who had experienced herb-drug interaction had high level of knowledge about herb-drug interaction. The difference was not statistically significant with Kruskall-Wallis (p=0,856). The low number of the size of the sample may limit our conclusion.

2.1. Herbs and conventional drugs that practitioners had experienced interactions with

The practitioners who said they had experienced herb-drug interaction were asked to report the herbs and drug that they had experienced interaction with.

Table 36 gives herbs and conventional drugs that practitioners have experienced interactions with.

Table 36. Herbs and drugs that the practitioners have experienced interactions with.

Herbs	Drugs	Number
Mitragyna inermis	Antimalarial	2
Guiera senegalensis	Pain killers	1
Coclospermum tinctorium	Antispasmodic	1
Combretum micranthum	Antimalarial	1
	Antibiotic (ampicillin)	1
Ximenia americana	Antimalarial	1
Cassia sieberiana	Antimalarial	1
Nauclea latifolia	Antimalarial	1
Cassia alata	Antiulcer	1
Ficus thonningii (Moraceae)	Antispasmodic	1
Burkea africana	Antidiarrhoeal	1
	Antifungal	1
Acacia senegal	Antifungal	1
Vernonia kotschyana	Antimalarial	1
Entada africana	Any drug	1
	Antibiotic (chloramphenicol)	1
Total		17

The practitioners reported 14 herbs and 11 conventional drugs that they had experienced interactions with. Among the herbs reported, one herb was a mixture of 59 plants (ourbatoudakilou); this herb was not taken into account in the table. This herb was experienced to interact with painkiller. *Combretum micranthum, Entada africana, Burkea africana* and *Mitragyna inermis* were the most frequent herbs with at least two drugs. The antimalarial drugs were the most frequently conventional drugs reported that interact with herbs.

3. Herbs and conventional drugs that practitioners asked their patients to take together.

The practitioners were asked if in their practice they told their patients to take herbs and conventional drugs together. The responses were categorized as: never, sometimes, often and always. The response rate was 96% (45/48). 49% (22/45) of the practitioners said they never tell their patients to take herbs and conventional drug together. 36% (16/45) of the respondents said they told their patients to take herb and conventional drug together sometimes while 17% (7/45) said often. No one of the respondents asked their patients to take herb and conventional drug together always.

The practitioners, who said that they tell their patients to take herb and conventional drug together, were asked to say how those herbs and drugs should be taken. The alternative responses were at the same time or at different times. The response rate was 98% (22/23) because one respondent did not answer. 77% (17/22) of respondents said they told their patients to take herbs with conventional drugs at different times. 5 respondents said they tell their patients to take herbs and conventional at the same time. Table 37 gives the herbs and drugs that the practitioners told their patients to take at different times.

Table 37. Herbs and conventional drugs that practitioners told their patients to take together and the reasons for taking them at different times.

Herbs	Drugs	Reasons	Number	%
Anogeisus leiocarpus	Antimalarial	One can cancel the	1	12
Mitragyna inermis	Antimalarial	effects of another	1	
Fagara xantoxyloides	Pain killers	One of them is taken	1	18
Landolphia heudelotii	Antiulcer	before and the other	1	
Entada africana	Any drug	after meal	1	
Anogeisus leiocarpa	Antimalarial	Effect of the interaction	1	18
Cassia sieberiana	Antimalarial	is not known	1	
Ourtoudakilou (59plants)	Pain killer		1	
Combretum micranthum	Antibiotic	Adverse effects	1	48
Mitragyna inermis		(diarrhea, vomiting etc)	1	
Opilia celtidifolia	Antimalarial		1	
Vernonia kotschiana	Antimalarial		1	
Vernonia kotschiana	Antimalarial antiulcer		1	
Mitragyna inermis	Antimalrial		1	
Sokorodje*	Antianemic		1	
Total			17	96

* I could not yet found the Latin name of that plant.

Four main effects were reported by 17 practitioners as main reasons for taking herb and conventional drugs at different times. These reasons were: Apparition of adverse effects (diarrhea, vomiting etc) for 48% (7/17), Effect of the interactions is not known for 18% (3/17), One of them is taken before and the other after meal for 18% (3/17) and One cancels the effects of another 12% (2/17).

C- Specific questions on practice

The practitioners were in the questionnaire asked certain specific questions about herb-herb and herb-drug interactions. Practitioners were asked if they were collecting information of relevance for interactions and if they were advising their patients before giving herbs. Some questions were also addressed to them regarding the types of advices they were giving to patients taking oral conventional drugs and the advices to patients taking a drug that has the same effect as the herb they were going to give.

1. Information of relevance for herb-herb and herb-conventional drug interactions collected by practitioners from their patients

The practitioners were asked if they were usually collecting information of relevance for interactions from their patients before they gave them herbs. The response rate was 98% (47/48). 72% (34/47) of the respondents said they were collecting information that is relevant for herb-herb or herb-drug interactions, 25% (12/47) said no and only one said don't know. Table 38 shows the information that the practitioners were collecting from their patients before giving them herbs.

Table 38. Information of relevance for interactions collected by practitioners from their patients before giving them herbs.

Information	Freq.	%
The history of the disease	20	42
If patients are taking a conventional drug	14	30
If patients are taking another herb	12	25
If patients have been seen by a medical doctor	9	19
The type of foods the patients are eating	4	8

"If the patients are taking conventional drug" and "If the patients are taking another herb" were the most frequent information of relevance for interactions for herb-herb or herb-drug interactions collected. 42% (20/47) of the respondents reported that they collected information related to the history of the disease. The history of the disease is not in my sense information that is relevant for herb-herb or herb-drug interactions; it is however important for the diagnosis of the disease.

2. Advices provided by practitioners to patients when giving them herbs

The practitioners were asked whether they advised their patients when giving them herbs. Those who advised their patients were asked to specify the advices they gave. Response rate was 96% (46/48) because two did not answer to that question. All the practitioners said (46/46) they advised patients before giving them herbs. 78% (36/46) said they advised their patients always, 20%(9/46) said they advised often and one respondent said he advised sometimes. Table 39 shows the advices giving by the practitioners to their patients before giving to them herbs.

Table 39. Advices that the practitioners provided patients when giving them herbs.

Advices	Number	%
Mode of use of the herb (mode of preparation and administration of the herb)	45	98
Posology of the herb (dose of the herbs to be taken and the frequency)	41	89
Contra indication of the herb	11	33
Side effects of the herb	10	22
Herb with which the given herb cannot be used	8	17
Herb with which the given herb can be used	4	9
The type of food to eat or to avoid	4	9
Drug with which the given herb can be used	3	6
Drug with which the given herb cannot be used	3	6

The most frequent advices given by practitioners to their patients were the mode of use of the herb for 98% (45/46) and the posology of the herb 89% (41/46). Only 17% (8/46) of the respondents told their patients about the herbs that cannot be used with the herb they gave.

2.1. Advices provided according to the level of knowledge of herb-herb interactions

The respondents were categorized according to the advices given and the results are given in the table 40.

Table 40. Advices provided when giving herbs according to the level of knowledge of herb-herb interaction

Level of knowledge about herb-herb interaction	Advices given by healers and herbalists to patients before giving herbs								
	The side effects of the herbs	Contra-indication of the herbs	The posology of the herbs (doses of the herbs and when)	The mode of use (how the herbs are used)	The herb not to take with	The herb to take with	The drug not to take with	The drug to take with	Food to take or not
Low Moderate High	5 3 2	5 2 4	28 9 4	32 9 4	3 2 3	2 1 1	2 0 1	3 0 0	3 1 0
Total	10	11	41	45	8	4	3	3	4

28 of the 41 practitioners who advised about the “posology of the herb” were categorized with low level of knowledge while four were categorized with high level of knowledge of

herb-herb interactions. 32 of the 45 practitioners who advised about "the mode of use of the herb" were categorized with low level of knowledge while four were categorized with high level of knowledge of herb-herb interactions. The low number of the size of the sample may limit that conclusion.

2.2. Quality of practice according to advices given when giving herbs

The respondents were categorized in poor good and very good practices (refer to method p.33) according to the advices they gave to their patients. Table 41 gives the practice about herb-herb interactions according to advices given.

Table 41. Quality of practices according to the advices given when giving herbs.

Quality of practice	N	%
Poor	28	61
Good	18	39
Total	46	100

61% (28/46) of the practitioners were categorized with poor practice towards the advices they provided to the patients before giving herbs. No one of the practitioners had scored very good practice.

2.3 Level of knowledge of herb-herb interactions related to the quality of practice concerning advices when giving herbs

Table 42 gives the level of knowledge of herb-herb interactions related to the quality practice concerning advices when giving herb.

Table 42. Quality of practice concerning advices when giving herb related to the level of knowledge of herb-herb interaction.

Level of knowledge about herb-herb interaction	Poor practice	Good practice	Total
Low	25	8	33
Moderate	5	6	11
High	0	4	4
Total	30	18	48

25 out 30 practitioners with poor practice and eight out of 18 practitioners with good practice were categorized with low knowledge of herb-herb interaction. The difference

was statistically significant by the Mann-Whitney test p=0,003. Then we reject the null hypothesis and conclude that there is a significant in the level of knowledge of herb-herb interactions between practitioners with poor practice and those with good practice.

2.4. Advices when giving herbs according to the level of knowledge of herb-drug interactions

Table 43 gives the advices according to the level of knowledge about herb-drug interactions.

Table 43. Advices given according to the level of knowledge about herb-drug interactions.

Level of knowledge about herb-herb interaction	Advices given by healers and herbalists to patients before giving herbs								
	The side effects of the herbs	Contra-indication of the herbs	The posology of the herbs (doses of the herbs and when)	The mode of use (how the herbs are used)	The herb not to take with	The herb to take with	The drug not to take with	The drug to take with	Food to take or not
Low	6	7	36	39	5	2	1	1	2
Moderate	3	3	4	5	2	1	2	2	2
High	1	1	1	1	1	1	0	0	0
Total	10	11	41	45	8	4	3	3	4

Out of the 45 who advised “on the mode of use of the herb”, 39 were categorized with low knowledge of herb-drug interaction while one was categorized with high knowledge. Out of the 41 who advised “on the posology of the herb”, 36 were categorized with low knowledge while one was categorized with high knowledge of herb-drug interactions. The low number of the size of the sample may limit that conclusion.

2.5. Level of knowledge of herb-drug interactions related to the quality of practice concerning advices when giving herbs

Table 44 gives the level of knowledge of herb-drug interactions related to the quality of practice concerning advices when giving herbs

Table 44. Level of knowledge of herb-drug interactions related to the quality of practice concerning advices when giving herbs.

Level of knowledge of herb-drug interaction	Poor practice	Good practice	Total
Low	27	13	40
Moderate	3	4	7
High	0	1	1
Total	30	18	48

27 out of 30 respondents with poor practice and 13 out of 18 respondents with good practice were categorized with low knowledge of herb-drug interaction. The difference was not statistically significant by the Mann-Whitney test p=0,10. We accept the null hypothesis and conclude that the observed difference is not significant. The low number of the sample size might limit this conclusion.

3. Advices that practitioners gave to their patients about the use of laxative herb with oral conventional drug

The practitioners were asked if they advised patients who take oral drug before they gave them a laxative herb. 46 respondents answered the question (46/48). 98% (45/46) of the respondents answered yes that they gave advices and one respondent answered don't know. The practitioners who answered yes were asked to specify the advices given. The 45 respondents reported seven different advices. Table 45 gives the advices.

Table 45. Advices that practitioners gave to patients about the use of a laxative herb together with oral conventional drug.

Advice	Number	%
Stop the conventional drug	21	47
Do not take the herb before you finish with the conventional drug	8	18
Take both (herb and drug) at different times by starting with the herb	4	9
Take both (herb and drug) at different times by starting with the conventional drug	4	9
Mode of use of the herb (mode of preparation and of administration of the herb)	4	9
Take both (herb and drug) together at the same time if the herb is antidiarrhoeal*	3	7
Continue with the conventional drug	1	2
Total	45	100

* This is relevant because there are some herbs that can be laxative in low dose and antidiarrhoel in high dose. This is the case with *Rheum palmatum* that contains anthranoid and tannins.

The majority of the respondents were not advising patients to take oral conventional drug with laxative herb together. The main advices that practitioners were giving to patients who were taking an oral conventional drug before giving them laxative herbs were: stop the conventional drug for 47% (21/45) and do not take the herb before you finish the conventional drug for 18% (8/45).

3.1. Quality of practice related to the use of oral conventional drug with laxative herb

The practitioners were categorized in poor and good practice (refer to method p.35) according to the advices they gave related to the use of oral drug with laxative herb. Table 46 gives the quality of practice related to the advices given.

Table 46. Quality of practices related to the use of oral drug with laxative herb.

Quality of practice	N	%
Poor	11	23
Good	37	77
Total	48	100

77% (37/48) of the practitioners were categorized with good practice regarding the use of oral drug with laxative herb.

4. Advices that practitioners gave when the herb and the conventional drug have same activity

The practitioners were asked which advices they would give to a patient who is taking drug that has the same activity as the herb they were supposed to give. Response rate (45/48). 45 practitioners reported seven advices. Out of them five reported don't know. Table 47 shows the advices given concerning the use of an herb having same activity as a conventional drug.

Table 47. Advices given by practitioners to a patient taking a drug that has the same activity as the given herb.

Advices	Number	%
Stop either herb or conventional drug	17	38
Do not take the herb before you finish the conventional drug	11	24
Take them at different times by starting with the conventional drug	5	11
Take them at different times by starting with the herb	3	7
Take them together by reducing the dosage of the conventional drug	2	4
Take them together at the same time	1	2
Take them at different times by observing a long time between them	1	2
Don't know	5	11
Total	45	100

In this case the great majority of the practitioners were not advising the patients to take herb and drug together. 38% (17/45) of the respondents advised "stop either the conventional drug or the herb" while 24% of the respondents, advised "do not take the herb before you finish the conventional drug".

4.1. Quality of practice related to the use of drug and herb having the same activity

The respondents were categorized in poor and good practice (refer to method p.34) according to the advices they gave when the drug and the herb have same activity. Table 48 gives the quality of the practice related to the use of herb and drug having same activity.

Table 48. Quality of practices when the herb and the drug have the same activity.

Quality of practice	N	%
Poor	11	23
Good	37	77
Total	48	100

77% (37/48) of the practitioners were categorized with good practice concerning the advices they gave when the herb and the drug have same activity.

II. Practice from the observational data

In this section I shall present the data collected from 12 traditional practitioners (ten healers and two herbalists), each being observed three times by using a checklist

(annex2). Two main parts will compose this section: practice about herb-herb interaction and practice about herb-drug interaction. I will refer to total number of consultations observed (i.e. 36 consultations) rather than the number of practitioners observed (i.e. 12 practitioners). The number of practitioners will be referred to when I talk about the questionnaire.

A. Practice about herb-herb interactions

1. Practice related to herb-herb interactions checked during observation of 36 consultations

A total of 36 consultations of 12 practitioners were observed. The practitioners were observed during through the whole consultations and a checklist was used to collect information as demonstrated in table 47.

Table 47. Practice related to herb-herb interactions checked during 36 consultations.

Practice checked during the observation	Consultations	
	Freq.	%
Healer/herbalist indicates side effects of the herb he is giving	31	86
Healer/herbalist asks if the patient is taking another herb	30	83
Healer/herbalist asks about the type of herbs the patient is taking	30	83
Healer/herbalist gives directives on how to take the two or more herbs	29	80
Healer/herbalist informs the patient to come back in case of interaction (unwanted or positive effects)	25	69
Healer/herbalist indicates side effects of a combination of herbs	20	55
Healer/herbalist presents list of herbs that cannot be taken with the given herb	2	6
Healer/herbalist presents list of foods that cannot be taken with the given herb	2	6

During 86% (31/36) of the consultations, the practitioners were indicating the side effects of the herbs they gave to patients. It was only during two consultations the practitioners told their patients a list of herbs that cannot be taken with the herb they were giving.

2. Cross analysis of practice related to herb-herb interactions checked during the observation compared with some answers from the questionnaire

The checklist related to herb-herb interaction contained some points that can be matched with parallel points in the questionnaire. Indeed the checklist had two main components: one was about the information of relevance for herb-herb interactions that the practitioners collected from their patients and another point about the advices they gave to patients when giving them herbs. Those two points were among the questions asked during the questionnaire interviews.

2.1. Information collected from the patients (questionnaire and checklist)

In this part we want to see if there is any difference between the information the practitioners reported to collect (questionnaire) and the information we observed them collecting (checklist). The information of relevance for herb-herb interaction asked in the questionnaire and checked during the observation was: if the practitioner asks the patients whether they were taking another herb. Nine respondents observed were also interviewed that yield to a total of 27 consultations and nine answers. The results are presented in table 48.

Table 48. Cross analysis of 27 consultations observed (checklist) vs. nine answers given (questionnaire) about the information collected: if practitioner asks whether patients are taking another herb.

Questionnaire (practitioners): n=9 Practitioner asks whether patients are taking another herb N		Checklist (consultations): n=27 Practitioner asks patients whether they are taking another herb	
		Yes	No
Yes	5	11	4
No	4	10	2
Total	9	21	6

Observed practitioners were asking their patients whether they were taking another herb during 21 consultations out of 27. But of the nine interviewed practitioners who were observed, five reported in the questionnaire that they asked the information, against four who said no. Out of the five who asked that information, four asked it during the consultation. We can see that some practitioners, who said no during the interview, asked the information during the observation.

To ask patients if they were taking another herb was a common practice among the practitioners.

2.2. Advices given reported during the interviews compared with the advices given during the observation

In this section we want to see if there is any difference between the advices reported from the questionnaire and the advices given during the observation (checklist). The comparison, in this section, will be done on the advices related to herbs that can or cannot be taken with the given herb and on the information given towards the side effects of the given herb.

2.2.1. Advice on the herbs that cannot be taken together with the given herb

The practitioners were asked what advices they gave to patients about the herb that cannot be taken together with the given herb. This advice was also checked during the observation. 11 practitioners observed were also interviewed that yield to 33 consultations and 11 answers. The results are given in table 49.

Table 49. Cross analysis of 33 consultations observed (checklist) vs. 11 answers given (questionnaire) about the advice given: a list of herbs that can or cannot be taken together with the given herb.

Questionnaire (practitioners): Practitioner presents a list of herbs with which the given herb cannot be taken		Checklist (consultations): Practitioner presents a list of herbs with which the given herb cannot be taken	
	N	Yes	No
Yes	3	1	8
No	8	1	23
Total	11	2	31

A list of herbs that cannot be taken with the given herb was mentioned only during two consultations out of 33. Out of the 11 interviewed practitioners, only three said they told the patients about the list of herbs that cannot be taken with the given herb and eight said they did not inform about that list. This result shows that the majority of the practitioners did not inform patients about herbs that cannot be taken with the herb they were giving. This was the case for both interviewed and observed practitioners.

2.2.2. Advice related to the side effects of the given herb (questionnaire vs. checklist)

The practitioners were asked what advices they gave to patients about the side effects of the given herb. This information was also checked during the observation. 11

practitioners observed were also interviewed that yield to 33 consultations and 11 answers. The results are shown in table 50.

Table 50. Cross analysis of 33 consultations observed (checklist) vs. 11 answers given (questionnaire) about the advice given: if practitioner advises about the side effects of the given herb.

Questionnaire (practitioners): n=11 Practitioner advises about the side effects of the given herb		Checklist (consultations): n=33 Practitioner advises patient about the side effects of the given herb	
	N	Yes	No
Yes	5	12	3
No	6	16	2
Total	11	28	5

The observed practitioners advised about the side effects of the given herb during 28 consultations out of 33. At the same time, five of 11 interviewed reported that they advised about the side effects of the given herb against six practitioners who did not. Many practitioners, who reported in the questionnaire that they did not advise patients about the side effects of the herb, did it in practice.
This result shows that the majority of the practitioners did inform patients about the side effects of the given herb during the consultations.

B. Practice about herb-drug interactions

1. Practice related to herb-drug interaction checked during the 36 consultations

A total of 36 consultations of 12 practitioners were observed. The practitioners were observed during through the whole consultations and a checklist was used to collect information as demonstrated in table 51.

Table 51. Practice related to herb-drug interaction checked during the 36 consultations.

Practice checked during observation	Consultations	
	Freq.	%
Healer/herbalist asks whether the patient is taking a conventional drug	33	92
Healer/herbalist asks whether the patient has been seen by a modern biomedical worker	32	89
Healer/herbalist gives directives on how to use the combination of herb with the drug	29	80
Healer/herbalist asks about the type of conventional drug the patient is taking	13	36
Healer/herbalist asks how the conventional drug is taken	10	28
Healer/herbalist informs about the side effects related to the use of the association/combination	10	28
Healer/herbalist tells about conventional drugs that can never be taken with the given herb	1	3

During 92% (33/36) of the consultations, observed practitioners asked their patients whether they were taking a conventional drug. Only during one consultation the practitioners told their patients about conventional drug that can never be taken with the given herb.

2. Cross analysis of practice related to herb-drug interaction checked during the observation compared with some answers from the questionnaire

The checklist related to the herb-drug interactions contained some points that can be matched with parallel points in the questionnaire. Indeed the checklist had two main components: one was about the information of relevance for herb-drug interaction that the practitioners collected from their patients and another point about the advices they gave to patients when giving them herbs. Those two points were among the questions asked during the questionnaire interviews.

2.1. Information of relevance for herb-drug interactions collected: if the patients had been seen by a medical doctor (questionnaire and checklist)

In this part we want to see if there is any difference between the information of relevance for interactions collected by the practitioners (questionnaire) and the information we observed them collecting (checklist). Two types of information of relevance for herb-

drug interaction were asked in the questionnaire and checked during the observation. This information was if the practitioner asks the patients whether they were taking a conventional drug; if the practitioner asks patients whether they have seen a biomedical worker. Nine practitioners were observed and also interviewed later. The results are given in table 52.

Table 52. Cross analysis of 27 consultations (checklist) vs. nine answers (questionnaire) about the information of relevance for herb-drug interactions: the practitioner asks patients whether they have seen a biomedical worker.

Questionnaire (practitioners): n=9 The practitioner asks patients whether they have seen a biomedical worker		Checklist (consultations): n=27 The practitioner asks patients whether they have seen a biomedical worker	
	N	Yes	No
Yes	9	23	4
Total	9	23	4

From the observation, the information for having seen a medical worker was asked during 23 consultations out of the 27. During the interview all the nine observed practitioners reported that they collected such information but the information was not collected during four consultations.

To ask if a medical doctor had seen the patients was a common practice among the practitioners interviewed as well as observed.

2.2. Information of relevance for herb-drug interaction collected: if the practitioner asks patients whether they are taking a conventional drug (questionnaire and checklist)

This information was obtained from nine respondents that lead to 27 consultations and nine answers. The results are given in table 53.

Table 53. Cross analysis of 27 consultations (checklist) vs. nine answers (questionnaire) about the information of relevance for herb-drug interactions: if the practitioner asks patients whether they are taking a conventional drug.

Questionnaire (practitioners): n=9 The practitioner asks patients whether they are taking a conventional drug		Checklist (consultations): n=27 The practitioner asks patients whether they are taking a conventional drug	
	N	Yes	No
Yes	2	5	1
No	7	19	2
Total	9	24	3

As shown in the table the practitioners asked the intake of conventional drug during 24 consultations out of the 27. At the same time, during the interviews two respondents only said that they collected such information against seven who said no. But among those who said no, many did it in practice because this information was collected during 19 consultations.

In practice traditional healers and herbalists asked their patients if they are taking conventional drug during the consultations. But when interviewed the majority of the practitioners said not asking for such information (7/9).

2.3. Advices given reported during the interviews compared with the advices given during the observation

In this section we want to see if there is any difference between the advices reported from the questionnaire and the advices given during the observation (checklist). The comparison, in this section, will be done on the advices related to drugs that cannot be taken with the given herb.

Cross analysis of 33 consultations (checklist) vs. eleven answers (questionnaire) about the advices given: if the practitioner tells patients the drug that cannot be taken with the given herb

This information was matched with the following information from checklist (the practitioner tells patients a list of drug that cannot be taken with the given herb). This information was obtained from 11 respondents that yield to 33 consultations. Table 54 gives the results.

Table 54. Cross analysis of 33 consultations (checklist) vs. nine answers (questionnaire) about the advices given for herb-drug interaction: if the practitioner tells patients the drug that cannot be taken with the given herb

Questionnaire (practitioners): n=11 The practitioner tells patients a list of drug that cannot be taken with the given herb		Checklist (consultations): n=33 The practitioner tells patients a list of drug that cannot be taken with the given herb	
	N	Yes	No
Yes	1	0	3
No	10	1	29
Total	11	1	32

The list of drugs that cannot be taken with the given herb was told to patient only once during the 33 consultations. From the questionnaire also only one respondent reported telling patients a list of drugs that cannot be taken with the given herb against ten who said they did not tell about that list. But the sole practitioner who told about this list of herbs in practice (during one consultation) had said in the questionnaire that he did not advised about that list.

This result shows that telling the patients a list of drugs that cannot be taken with the herbs was not a common practice among the interviewed and observed practitioners.

Chapter 5. DISCUSSION; CONCLUSION; RECOMMENDATIONS

I. Discussion

The aim of this study was to determine the level of knowledge of herb-herb and herb-conventional drug interactions and also the practice concerning herb-herb and herb-conventional drug interactions among the healers and herbalists operating in Bamako and registered by the Department of Traditional Medicine (DMT). To determine the level of knowledge a cross-sectional survey using semi-structured questionnaire was designed. The level of knowledge was determined according to the effects that could result from interaction between two herbs and between herb and drug. The level of knowledge (herb-herb and herb-drug interaction) of healers and herbalists was categorized as low, moderate and high. Two types of data collection were used to determine the practice: a cross sectional survey using the same questionnaire as in the knowledge part and a non-participant observation using a checklist. The questionnaire was used to determine the following aspects of the practice: categories of medicines used by healers and herbalists, the most frequent herbs used by healers and herbalists, the combination of herbs used, the herbs that should never be taken together, the herbs that can be combined with conventional drug, the herbs that should not be used with conventional drug and the effects that can result from all these combinations. The checklist was used to see what the healers and herbalists were doing during their consultations (information of relevance for interaction collected and the advices given when giving herbs).

1. Characteristics of the respondents

The majority of the respondents were herbalists (26/48) and more than half (18/26) of the herbalists were female. Our results about the gender of the herbalists are supported by the previous studies. Traditionally the majority of the herbalists in Mali are females (35) (43). This might be explained by the role the women are playing in the economical support in the families in Mali.

The majority of the respondents were also illiterate (37/48). Our finding is in the line of what was reported before. In fact Traore (43) by addressing the obstacles of the promotion of traditional medicine in Mali had identified the illiteracy as one of the problems. Also in Mali the illiteracy rate is about 46% (1).

The majority of the practitioners had inherited the practice of traditional medicine (30/48). This shows that the practice of traditional medicine still remains as family practice. Another interesting thing about the background of the practitioners is that people who did not have inherited the practice of traditional are practicing it now; at the same time most of them are practicing as herbalists. Economical reasons could explain this. There is a need to find out the reasons that motivate people with no traditional medicine practice background to perform it.

The practitioners who did not attend workshop on the collaboration between the traditional and conventional medicines claimed that they were not invited. The invitations for attending workshops were usually sent to the representatives of the associations or those who were able to read and write.

2. Methodology

2.1. Strength of the study

The use of cross sectional design with open questions is suitable for determining the categories of medicines used by practitioners, the herbs that can interact, those that can be used or not together, those that can be used with or without conventional drugs and the herbs frequently used by practitioners and also the level of knowledge. The limitation of this type of design is that the results cannot explain reasons for the interactions (44). Cross-sectional design has been used to investigate the use of alternative medicine in USA. Yoon (36) used survey questionnaires to determine the use of herbal medicines among women in USA. A survey was also used in Eastern Cape (South Africa) to determine the source of self-medication and the herbal medicines used by the *amayeza* stores (45). In a cross sectional study all information about the practitioners and the herbs used by them can be collected at the same time for a very short period. The cross-sectional survey is a suitable design when the phenomenon under investigation is rare. This is the case in the herb-drug interactions. This type of design gives us baseline data on the phenomenon of herb-herb and herb-drug interactions.

In our study the questions were asked in Bambara while written in French. To limit the loss of information related to that fact a pilot study and a two-day training session for the second interviewer were done before data collection. Both interviewers were skilled in Bambara and French. Other studies conducted in Mali had used the same type of data collection (that means to make the interview in Bambara while the questions were written

in French). Liv Elin Torheim (46) used the same method when studying the nutritional status of the children in Koutiala Distinct. Persons skilled in Bambara and Minianka (local language in Koutiala) administrated her questionnaire. The data obtained from the questionnaire may have increased in validity because the practitioners were not asked to give the names of the diseases against which the herbs were used.

The use of a non-participant observation might have limited the potential biases that might occur during the questionnaire interview. Observation can be an effective method when combined with other methods such as interviewing (41). To avoid the influence during the interview we have started the data collection by the observation. The fact to start the data collection by the observation avoids the influence that might have occurred because of the interview. The use of open question helped to get information about the effects that might occur in case of interaction and the advices given to the patients by the respondent's own words.

The test of the questionnaire with eligible practitioners (pilot study) before data collection increases the validity and the reliability of the results. Using two methods of data collection also may have increased the validity of the data. The use of two interviewers could bring inconsistency and variability in the answers reported. To reduce the inconsistency and variability in the answers reported, the research assistant and the main researcher were meeting every evening after each séance of interview to cross check the responses. This allowed us to identify missing answers and go back to the respondents to get that information. Also during those meetings we were discussing some difficulties that occurred during the interviews and we coordinated ways of asking questions. The collection of the observation data by the main researcher himself limits the biases of those data this because he was aware of these biases. In a non-participant observation the skill of the observer is an important tool for the validity of those data (41)

2.2. Limitation of the study

The following aspects may limit the findings of the study, both related to the questionnaire and the checklist.

The findings from the questionnaire may be biased because of the presence of the interviewer. His/her presence might have influenced the respondents to say what they thought or were convinced are right. This for example might happen when it comes to the

questions related to the advices the practitioners were giving or the information of relevance for interaction they were collecting from patients. This is illustrated by some answers the respondents gave from the questionnaire while observed they were not doing so. On the other hand the opposite happened too. The non-use of random sampling to get the study sample is because the total number of healers and herbalists registered and operating in Bamako was small (n=123). We chose the sample by convenience in order to be able to get information from the participants who were involved in the study. The choice of the sample by convenience was done because of the fear for getting low response rate. The low number of the sample and the mode of selection (by convenience) limit the generalization of the results to the practitioners registered by the DMT and operating in Bamako. The practitioners who accepted to participate might have done so because they supposed they were more knowledgeable of herb-herb and herb-drug interactions than the other who did not. The size and the mode of selection of the sample therefore limit the generalization of the results.

The observation could better have sorted out the practice of the practitioners, if all of the interviewed had also been observed. In fact only 12 practitioners were observed out of 48 interviewed. Because of those limitations the findings cannot be generalized to all practitioners operating in Bamako.

The logistic regression analysis could have been used to see the contribution of each independent variable to the level of knowledge of herb-herb and herb-drug interactions. In our study the level of knowledge had three categories (low, moderate and high), this prevented us to use the logistic analysis. Because the logistic regression is used when the variables of interest are continuous or have two categories (44)

3. Knowledge of herb-herb interaction

The majority of the respondents reported positive effects of the interaction. The majority of the respondents (79%=38/48) reported, “The effects of both herbs can be increased” while 35% (17/48) reported, “One herb can increase the effects of another”. The majority of our sample (91%) shared the opinion that there is always increase of the effects of both herbs when taken together. At the same time no one disagreed with those two statements. However six practitioners reported that another herb could increase the side effects of one herb.

The fact to report beneficial effects of interactions could be explained by the fact that the healers and herbalists reported effects according to what they do in practice. The big majority (39/48) of them had been practicing more than five years. They were probably reporting what they thought was acceptable or logical. This finding can be supported by that reported by Vickers and Zollmann (32) when addressing the expectations of herbalists about herb-drug interactions. They reported that practitioners usually say that the principles of synergy and buffering apply to combination of herbs and they claim that combining herbs improves the efficacy and reduces the adverse effects of the plants.

69% of the practitioners were categorized with low level of knowledge of herb-herb interactions. We have not found any study in the literature focusing on the quantification of the level of knowledge of herb-herb interactions of traditional practitioners. Therefore we can only give our own interpretation of the observed phenomenon. The low level of knowledge of herb-herb interactions could be explained by the following reasons. First, the practitioners were answering according to their own experience. The healers and herbalists were probably showing that they were mixing only herbs that they thought had positive effects. That means they only think about the positive effects of interactions. Secondly, the methodological artifact could also explain the low level of knowledge observed because the practitioners did probably not understand exactly the meaning of interactions and also because of the way of scoring them. The practitioners when asked to rate their own knowledge, only six considered themselves with low level of knowledge while 27 and 15 respectively considered themselves with moderate and high. However the difference was not significant between their own level of knowledge and the level of knowledge they scored (p=0,176). The interactions in general could have both positive and negative effects (47). The healers and herbalists fear by thinking that we were checking in which way they mixed herbs despite the fact the questions were clear or in which occasion they mix their herbs. However the positive reported could be used by the DMT for the development of new ITMs.

Impact of the observed low level of knowledge of herb-herb interactions

A very flexible scale of categorization of the level of knowledge of herb-herb interactions was used. To be categorized with moderate level, the healer or herbalist should have reported at least one positive effect and one negative effect of the interaction. Therefore

the way of categorization of the knowledge of herb-herb interaction could have permitted healer or herbalist to score higher level of knowledge.

Despite this flexible (easy) way of scoring, the majority of the practitioners were still categorized with low level of knowledge. In addition, when asked to state their own level of knowledge of herb-herb interaction, the majority of the respondents (27/48) considered themselves with moderate level of knowledge. The low level of knowledge of herb-herb interactions observed might have some impacts on the future research for the development of ITMs by the DMT and may be for less impact on the herb users.

First for the DMT on the ITMs production: One of the objectives of the DMT is to produce ITMs. Since the healers and herbalists have low level of knowledge of herb-herb interactions this could limit the information that might be given to patients. The healers and herbalists are the information providers about herbs to the DMT because they are the holders of knowledge about medicinal plants.

Secondly for the patients: The healers and herbalists reported that they often (78%) told patients to take different herbs together at the same time. Some healers and herbalists reported that there are severe or mild consequences (diarrhea, increased toxicity, vomiting etc) that could result from interactions between different herbs and also other herbs could cancel the effects of some herbs. Most of the herbs may be regarded as safe because of historical long use; there are however some herbs that could have toxic effects (48) (49). Since the healers and herbalists do not in their majority think about the negative effects (this consequence of the low knowledge) that might occur when combining herbs and because of the intrinsic toxicity of some herbs there might be a risk for users to develop some manifestations due to the combination of antagonist herbs. Also the practitioners might have cases of herb inefficacy because some herbs might cancel the effects of others as some of them have reported.

In the light of this fact, there is a need for investigating more about the effects of single herbs and also about the effects of combined herbs.

Analysis of the level of knowledge according to some independent variables

A statistically significant difference was observed between healers and herbalists in the level of knowledge of herb-herb interactions *(*p=0,017). There are probably two reasons for this. The healers are in contact with patients more than the herbalists are. Almost 41% (9/22) of the healers in the sample had formal schooling of more than 10 years; only two herbalists (2/26) had been to school and this for only nine years.

More than half of the herbalists were females compared to the big majority of the healers who were males (19/22). The male practitioners were likely more knowledgeable of herb-herb interactions than the female practitioners (p=0,014). This could be explained by the fact that most of the males had been to school and had attended workshops on herb-herb interactions, which is much higher than the females. In the tradition in Mali the girls were not supposed to go to school, but now there are some efforts put in for increasing the schooling of the girls.

There was a significant difference in the level of knowledge according to the background of the practitioners. The practitioners with inherited background were likely more knowledgeable of herb-herb interactions than the non-inherited ones (p=0,03). This could be explained by the fact that the practice of traditional medicine used to be taught within the families practicing the traditional medicine. In Mali as reported by Diallo (35), the empirical knowledge on medicinal plants is mainly held by traditional healers and herbalists. The knowledge of traditional medicine cares and herbs was obtained from generations to generations (5).

The practitioners who had formal schooling were likely more knowledgeable than those with no formal schooling (p<0,001). This could be explained by the fact that the majority of the participants of the workshops on the collaboration between traditional and conventional medicines were those who had formal schooling. The attendance to a workshop showed a significant difference in the level of knowledge (p=0,004). During the workshops some topics of interest were discussed like the production of ITMs, herb-herb interactions and disease control. There was however no significant difference according to the topics and the time of attendance to the workshops in the level of knowledge. The low number of practitioners in each group could explain this.

Other factors like age and the length of time in work did not shown any significant difference in the level of knowledge of herb-herb interactions with respectively p values 0,22 and 0,59. The experience and the age of practitioners could have an impact on the level of knowledge. The low number of the sample size might explain this.

4. Practice about herb-herb interactions

4.1. Categories of medicines used

Healers and herbalists in our sample used four categories of medicines: herbs (100%, n=48), ITMs (23%, n=48), mineral elements (12%, n=48) and animal products (6%, n=48). Our findings corroborated with those of Koumaré. In fact Koumaré in 1978 (50) reported that traditional practitioners used both animal-based products and minerals but they were mainly using plant based-substances. The traditional medicine in Mali encompasses the utilization of substances (herbs, animals, and mineral elements); dosages and practices are based on socio-cultural norms and religious beliefs as well as witnessed experiences and observation of a specific group (5). A part of the background of our study showed that the use of ITMs is gaining more interest among practitioners. Two reasons could explain this. Since 1995 the existence of the law allowing healers and herbalists to open traditional clinics or herbal shops (units of production of ITMs) could have stimulated many healers and herbalists to use those new types of medicines. By making ITMs, the healers or herbalists could think that they gained better notoriety in the society. The people would probably consider healers and herbalists using ITMs as having both traditional and modern medicine knowledge. In addition the people might consider the medicines (ITMs) used by these practitioners as safe because they are clean and have doses. Healers and herbalists using ITMs might think that they get more variety of clients and consequently gaining more money. More investigation might be needed to find the reasons for healers and herbalists to turn into ITMs.

4.2. Most frequently herbs used by healers and herbalists

The three most frequently used herbs were *Mitragyna inermis* (32%, n=46), *Cassia sieberiana* (28%, n=46) and *Trichilia emetica* (24%, n=48).

Mitragyna inermis (Willd.) O Ktze (Rubaceae). Bambara name: Djoum

Mitragyna inermis is a tree up to 16 m high, bole up to 60 cm diameter, low branching; of damp perennially flooded sites, swampy savanna, or inland side of coastal mangrove; common across the Region from Mauritania to W Cameroon, and into the Congo basin and Sudan (51). The leaves and the bark have many medicinal uses. The bark is used in pregnancy complications, stomach disorders, dysentery, fever and nausea. The preparations of the leaves are put into baths and taken by draught for debility and cachexia in disease, arthritis, myalgia and general pain. *M. inermis* was tested for

larvicidal activity. A methanol extract at concentration of 0.5mg/ml gave about 30% mortality against *Anopheles gambiae ss* larvae (52).

Cassia sieberiana DC. (Caesalpiniaceae), Bambara name: Sindja

Cassia sieberiana is a very attractive shrub or small tree, 7-15 m high. The flowers are bright yellowing in pendulous. *C. sieberiana* is widely spread from Senegal to Tanzania, Sudan. It is also widely used as medicinal plant in Africa. In the whole Senegal and Gambia, the leaves and peeled roots are used as a purgative and diuretic. In Mali, the roots have a reputation as a medicine for many diseases: failure of urinary production, intestinal parasites, leprosy, edemas, venereal diseases, impotence, fatigue, pain, feverish stiffness of the limbs, etc. The presence of anthraquinones in the leaves and roots may explain the purgative effects. The large amount of flavonoids may explain the diuretic, anti-inflammatory, antibacterial and antidiarrhoeal effects. The herb also contains tannins. Samples from Mali have shown a high amount of flavonoids in the leaves with quercetrin and isquercetrin as the major components (53).

Trichilia emetica Vahl. (Meliaceae), Bambara name: Filafinza

Trichilia is a shrub or small tree up to 10 m high with a trunk of 5-15 cm diameter, crooked, low-branching, narrow crown, evergreen. *T. emetica* can be found in the savanna and in Cameroon, Central African Republic, Sudan and Uganda. In Mali, the plant is available in the southern areas. The plant has different uses in traditional medicine. It is one of the plants that were identified in Mali as wound healing especially old wounds (35). The bark is used against troubles associated with stomach such as gastritis, hepatitis, internal tumor and ulcers. In Mali, *T. emetica* is also used against malaria, cough, and dysmenorrheoas. It is also used as antidote (emetic) against poison and as purgative. The plant contains limmonoids (trichilines as antifeedant against insects). The dried leaves of *T. emetica* have been extracted with water at 50°C and 100°C. The crude extracts contain 43% and 39% of polysaccharides. The extracts contain different types of polysaccharides that can be responsible of the complement fixation activity. This can also explain the use of the plant by traditional healers for the treatment of wound in different places. The herb contains also tannins (35)

The fact to find that those plants were the most frequently used herbs is not surprising. The herbs frequently used could probably have interaction with conventional drugs. The

presence of tannins and polysaccharides in both *C. sieberiana* and *T. emetica* might probably lead these herbs to have potential interactions with conventional drugs.

In Yemen, Attef (23) by studying the influence of Khat chewing on ampicillin and amoxicillin bioavailability reported a significant decrease of that of ampicillin. However no effect was noted with amoxicillin. This was may be due to the tannins that constitute the main components of Khat. The tannins may also reduce the absorption of anti-psychotic drugs (17). The polysaccharides can reduce the absorption of orally taken drug because of the non-total absorption of the polysaccharide and then form a barrier for the conventional drugs. On the other hand the presence of polysaccharides may probably be beneficial for interactions. In fact it is reported that carbohydrates containing herbs could reduce the dose of insulin in insulin dependent-patients (14).

For *C. sieberiana* the presence of anthraquinones and flavonoids (quercetrin) may be responsible of interactions with conventional drugs. The anthronoid-containg herbs may reduce the absorption of concomitant administrated orally drug because of the increase of the increase of the intestinal speed (27). Flavanoids especially quercetrin and kaempferol inhibit the metabolism of dihydropyridin calcium channel blockers (nifedipin, filodipin, nitridipin and nisoldipin) (54). Therefore the presence of quercetrin in the roots of *C. sieberiana* (roots being the part of the plant mostly used) could probably yield to interactions in patients under calcium channel blockers.

4.3. Herbs that can interact

Trichilia emetica with *Anogeissus leiocarpa*, *Nauclea latifolia* with *Mitragyna inermis* and *Anogeissus leiocarpa* with *Mitragyna inermis* were the herbs reported that could interact. The practitioners claimed that the effects of these interacting herbs would increase when those herbs were taken together.

There might be synergism or antagonism between different herbs because most of the traditional medicines are mixtures of different components. Furthermore, new components might be formed from the interaction between these components. Berberine (alkaloid) can combine with the glycyrrhizin (from licorice) to from a new chemical with potentially different pharmacological properties (17).

Few evidences exist on the interactions between different herbs. The difficulties related to the issue are mainly: first plants are composed of mixtures of different chemical components that can interact between them. We can therefore only rely on the information the practitioners gave according to their experiences. The traditional

practitioners have often developed their knowledge over years of practice. These healers know precisely which plant parts, which decoctions and which dosages to use. They can also give information as to when to pick the plant and where to find it. The information obtained from ethnomedical sources could help to isolate numerous biologically active plants compounds (55). Most of those herbs are used medicines against malaria or for wound healing; therefore the practitioners might thing in term of synergism between these different herbs. The interactions may occur in pharmacodynamic and pharmacokinetic mechanisms (47). The pharmacodynamic would mostly be the effects that practitioners could interpret. The information obtained from practitioners about these combinations could be used for the development of new ITMs.

4.4. Herbs that healers and herbalists never used together

Securidaca longepedunculata Fresen. (Polygalaceae) and *Swartzia madagascariensis* Desv. (Caesalpiniaceae) were the most frequently reported herb combinations not to take together. The consequence that could result from this combination was mainly: increased toxicity, profuse diarrhea.

Securidaca longepedunculata, Bambara name: Djoro.

S. longepedunculata is one of the most beautiful African flowering shrubs or trees, 2-10m high, with a thin trunk, erect branches and stiff, erect leaves (48). The flowers are bright purple, fragrant, in terminal clusters. The plant is widespread in the tropical Africa and South Africa. The plant is a common savannah tree, also present in open forests and almost always on sandy ground. The plant is believed to be a very powerful medicinal plant and Neuwegen (48) wrote, "The Hausa in the Northern Nigeria call it "the mother of medicines". The roots are used the most; they are still poisonous like the stem bark and the seeds, but less dangerous than the stem bark and apparently harmless when used externally and as an embrocation; orally it does normally not cause ill effects. It is used for the following complaints: rheumatism, backache, headache, toothache, earache, chest and stomach pain, malaria, as a drastic purgative and emetic, etc. The roots have a wide reputation as an abortifascient among the Mossi in Burkina Faso. Neuwegen (48) in his book wrote: "In the roots saponines were found with 1,34% acid and 0,94% neutral saponines in the roots bark from Tanzania. Salicylic acid methylester as the major components of the roots along with triterpene saponines, tannins and sterols were also found. In the stem bark an alkaloid, which proved to be identical to the very toxic

securinine, previously isolated from *Securinega suffruticosa* Rhd (Euphorbiaceae) was also extracted". Securinine has a stimulating effect on the central nervous system, especially the spinal cord. It also influences the function of the autonomic nervous system. The saponines from the roots are regarded as the toxic principles. The larges among of methylsalicylate is not acutely toxic at 700mg/kg guinea pigs and humans reacts more sensitively LD50= 170mg/kg orally.

Swartzia madagascariensis *(Caesalpiniaceae)*

The plant is widely used as hunting poisons in many African countries. The fruit are the classic additive to the larva arrow poison of the Kalahari. However Neuwenger (49) wrote: " The fruit do not by any means belong to the most poisonous representatives, however the fruit used as poisons so determinedly in poison making is an answered question". In Senegal and Zambia the fruit is reputed to be an abortificient. Wolof and Serer in Senegal use the roots in the treatment of syphilis and leprosy. In Senegal Fulani uses again the root, twig bark and the macerate of grilled fruit as purgative. In Benin the combination of Swartzia with *Parkia biglobosa* is used against convulsion (49). A paste made from the root bark of Swartzia together with *Aframomum melegueta* and some water is applied on drepanocytaemia. The Bemba in Zambia uses the macerate water of the bark of Swartzia as laxative and as an emetic. In the fruits from Mali catechin-tannins, a strong hemolytic saponine as well as a flavonoid (kaempferol) were found. The seeds also contain strongly hemolytic saponine. The toxicity of the fruits from Mali had been demonstrated with fish. The seeds are more hemolytic than the seedless fruits. The swartzia-saponine A of Sandberg showed a very strong hemolytic index (49).

The non-use of *Securidaca longepedunculata* and *Swartzia madagascariensis* together and with other medicinal plants could probably be related to the toxicity of these plants. The healers might fear the increase of the toxicity of the combined plants. The saponines from Swartzia have been reported to be very hemolytic. During our fieldwork some healers were telling us that the *Samacara* (Bambara name of Swartzia) was a plant with *baga* (term used by healers to explain toxicity due to evil spirit). For them this plant is very difficult to manipulate because it is surrounded by evil spirit. Therefore to be able to use it the practitioner should be initiated. The same was applied to Securidaca (Djoro in Bambara). An alkaloid extracted from Securidaca was identical to securinine (from (*Securinega suffruticosa*) which has been proven to be very toxic. Securinine is

extremely fast working and unusually rapidly metabolized in the organism both by parenteral and oral administration. The acute toxicity of securinine was investigated in mice, rats, rabbits, dogs and monkeys in comparison with strychnine (48). Securinine acts primarily upon the spinal cord, causing enhancement of reflex activating and increase in muscular tone in animals. In toxic doses it induces powerful tonic convulsions involving all skeletal muscles, similar to strychnine convulsions. The toxic dosage of securinine causing convulsions is very close to that causing death and is 12-30 times larger than that of strychnine. Most of the animal died during convulsions due to respiratory arrest. The healers and herbalists not using those herbs together or with other plants can be explained by the toxicity of those two plants. The consequence that could result from the combination between Securidaca and Swartzia was mainly increased toxicity. Since the two plants are very toxic the non-concomitant use of them could be understood. In some case the healers and herbalists had reported that *Securidaca* and *Swartzia* should not be mixed with any other plant and the consequence of that could be fatal i.e. yielding to death. *Securidaca longepedunculata* when used with *Afrormosia laxiflora* may yield to mild clinical consequences (diarrhea, dizziness, and headache). The toxicity related to *S. longepedunculata* could explain this.

4.5. Herb-herb combination used

The healers and herbalists in their big majority (95%, n=44) were asking patients to take different herbs together at the same time. The main reason for that was that they thought the effects of one herb reinforce the effects of the other. *Mitragyna inermis* and *Anogeissus leiocarpa* were the most frequent combination.

In the literature we have not found specific studies on the combination of these herbs. According to the literature found with each of the herbs and based of the traditional medical uses of those herbs, the fact that practitioners combine them is not surprising. *A. leiocarpa* is one of the herbs used as ITM in Mali. The practitioners might combine those two herbs because both of them traditionally are used in Mali as antimalarial and against fever (35). As said with the herbs that can interact, the practitioners combine those herbs according to their experience.

Therefore we can use the information the practitioners give about effects that could result from the combinations of herbs to develop new Improved Traditional Medicines.

5. Knowledge of herb-drug interactions

We have not found any literature that focus on the level of knowledge of herb-conventional drug interaction among traditional practitioners.

When it comes to herb-drug interactions only 58% (n=48) of the practitioners answered yes when asked "Can an herb interact with conventional drug when both are taken together" compared to 100% when asked about herb-herb interactions. The practitioners who answered no or don't know said that herbs and conventional drugs are the same types of medicines and therefore there is no need for taking them together. This shows that the practitioners are not very often advising their patients to take different herbs with drug. The majority 86% (56% and 30%) of the respondents reported the beneficial effects of herb-drug interactions. 56% (15/23) said the effects of the herb and the drug can be increased when both are taken together. The effects of one can be increased by the other was reported by 30% (8/23) of the practitioners. This can be explained by the fact that the healers and herbalists had answered according to their practice. In that sense may be they sometimes do things, which they think were logic by reference to their traditional use of medicine. Or they also wanted to show us that the herbs they used were not harmful but complementary to the conventional drugs. It might also be because they wanted to show that they were doing only good things. Also when asked about the herbs that can interact with conventional drugs they all gave example of herbs and drugs that they said had positive effects when taken together. But there were some practitioners who disagreed with the statement that the effects of the herbs or drug are always increased when both are taken together.

Most of the effects that healers and herbalists reported as result of herb-drug interactions had been reported in the literature both positive and negative (29). Brinker (18) has sorted out some of the positive effects of herb-conventional drug interactions as I presented in the introduction. I shall discuss specially the negative interaction below when it comes to the impact that the low level of knowledge might have.

The majority 83% (n=48) of the practitioners were categorized with low level of knowledge of herb-drug interactions, 15% (n=48) with moderate knowledge while only one respondent was categorized with high level of knowledge. No studies were found focusing on the quantification of the level of knowledge of herb-drug interactions. The following aspects could explain the low level of knowledge of herb-drug interaction observed:

- In the combination of herb with conventional drug the practitioners could have referred to their traditional knowledge of herb-herb interactions. The healers and herbalists were probably not very much aware of the interactions between herbs and conventional drugs. The healers and herbalists in their majority don't know much about conventional drugs. Conventional medicine in general is a new phenomenon among traditional medicine practitioners. Based on the age of the healers and herbalists we can understand that during their traditional training they did not get any information about conventional drug by then. In practice in mixing different herbs they use their own knowledge about the effects of each herb but for mixing herb with conventional drug, they don't know the drug and may be the drugs they know are probably the antimalarial ones (chloroquine). Therefore they would think that since the herb they are giving is against malaria then this herb could increase the effect of an antimalarial drug. That means they only think about the positive effects of interactions.
- The methodological artifact might explain the low level of knowledge observed because the practitioners did not probably understand exactly the meaning of interaction as in herb-herb interactions (positive and negative effects) and also because of the limitation of the scoring. As in herb-herb interactions, the practitioners were asked to rate their own level of knowledge. By opposite to herb-herb interactions, no practitioner had considered him-self with high level of knowledge. However the majority of them considered themselves with moderate level of knowledge of herb-drug interactions. Here too the difference was not significant between their own level of knowledge and the level of knowledge they scored (p=0,300). The healers and herbalists fear that we were checking in which way they mixed herbs with conventional drugs despite the fact that the questions were clear or in which occasion they mix their herb with conventional drugs. They could probably suspect that we were judging their practice. The practitioners were probably trying to show that they gave herbs that only help the conventional drugs to act and those herbs were safe. For example 22 out of 45 said they never their patients to take herbs and conventional drugs. Those who said they told their patients to take herbs with conventional drugs claimed they told them to take those products at different times.

Impact of the low level of knowledge about herb-drug interactions

The occurrence of herb-drug interaction is higher than that of drug-drug interaction (30). Most of the herbs have different chemical components that might interact with conventional drugs. The mechanisms of interactions between herbs and conventional

drugs are not all completely well established. The low level of knowledge of herb-drug interactions observed could have strong impact in terms of clinical consequences for patients who use herbs. There are many studies that have been conducted to put into evidence the herb-drug interactions.

Sundaram et al (21) have studied the influence of herbal antidiabetic Diabecon (D-400) on the metabolism of tolbutamine and glybenclamide; there was an increase in plasma concentration of the two drugs when co-administrated with the herb in animal model. In another study composed of animal experiments and clinical trial, the pharmacokinetic interaction of Diabecon (D-400) was evaluated with rifampicin and nifedipin. The plasma levels of rifampicin in animals was not significantly affected by single dose by D-400, this also was the case for nifedipin. In clinical study, there was also no significant influence of the D-400 on the plasma concentration of rifampicin. The drugs are may be metabolized by an entirely different way (20).

The effects of Sho-saiko-to (Chinese traditional medicine) were investigated on the pharmacokinetics of tolbutamine. There was no significant change on the pharmacokinetics when tolbutamine was administrated by intravenous route. But there was an acceleration of the intila absorption rate of the drug (56).
It is known that herb containing tannins could decrease the absorption of conventional drug (23) (17). Also anthranoid-containing herbs might decrease the absorption of orally taken herbs and thus reduce the bioavailability of these drugs (19) (27). The long-term use of stimulant laxative herbs can increase the loss of serum potassium, thereby potentiating cardiac glycoside and antiarythmic drug (27). The loss of potassium also can be increased by simultaneous use with diuretic. Some of the herbs used by the practitioners contain anthranoids and flavonoids, which are known to have laxative, purgative and diuretic effects. Therefore the use of those herbs with some conventional drugs can be dangerous for patients. Since the level of knowledge of herb-drug interaction was low, there is a need to train healers and herbalists about it. However there is a lack of knowledge about some of the mechanisms of herb-drug interactions.

5.2. Analysis of the level of knowledge according to some independent variables

A significant difference was observed in the level of knowledge of herb-drug interactions between male and female practitioners (p=0,024). This difference could be explained as

in the case of herb-herb interactions by the fact that the males had in their majority been to school, which was not the case for the females, and also the herbalists are in majority females. In herb-drug interactions no herbalist was categorized with moderate or high level of knowledge.

A significant difference was observed between the two age groups (28-50 years and more than 50 years) in the level of knowledge of herb-drug interactions (p=0,005). The finding that younger practitioners were likely more knowledgeable about herb-drug interactions than the older ones could be explained because the young are more adopted to change with modernity and wanted to know more. The oldest practitioners are still willing to stay behind their tradition. The young practitioners are may be participating more to the activities of collaboration between traditional medicine and modern biomedicine.

The healers and herbalists did not differ in the level of knowledge of herb-drug interactions (p=0,17) while they do differ in the level of knowledge of herb-herb interactions (p=0,017) The non significant difference in herb-drug interactions could be explained by the fact that conventional medicine is not a phenomenon that those practitioners had learnt from the family but from their own experience. The non-significant difference observed might also be because of the low number of the sample. When the sample is small the difference observed might have occurred only by chance.

The level of knowledge of herb-drug interactions did not differ between practitioners with inherited background and the practitioners with no inherited background (p=0,29) while the difference was significant for herb-herb interactions (p=0,03). The non-significant difference in the level of knowledge of herb-drug interactions could be explained by the fact that herb-drug interactions is not a phenomenon that those practitioners learn from the family but mostly from their own experience. In fact most of the practitioners that said having knowledge from their own experience, and at the same time 42% (n=48) of the practitioners do not mix herb with conventional drugs. But the low number of the sample may also be the reason for not observing significant statistic difference in the level of knowledge of herb-drug interactions.

The difference in the level of knowledge of herb-drug interactions was not significant with the other factors: schooling, attendance to a workshop, and length of time in work. The low number of the sample could be the reason for that.

5.3. Herb that can interact with conventional drugs

Fourteen herbs and eleven conventional drugs were reported by healers and herbalists, which could interact when taken together.

Mitragyna inermis and *Nauclea latifolia* were reported to increase the effects of antimalarial drugs while *Sclerocarya birroea* increases the side effects of heart medicines when both are taken together. *Nauclea latifolia* is traditionally used against malaria and as wound healing plant (35). *Sclerocarya birroea* is a tree in the Savanna. The fruits are used in trade mostly in Burkina Faso. The fruits are ovoid drupes, white yellowish. People use it as a drink because it is rich in alcohol. The fruits are also rich in fat and vitamin C (57).

In the literature it is reported that the combination of herb with conventional drug can be beneficial or negative depending upon the chemical composition of the herbs, the type of drugs or the ways of administration of the herbs or the drugs. The mechanism of herb-drug interactions could occur in many ways: decrease bioavailability, increase bioavailability, additive effects, protection from side effects, increase side effects and antagonistic effects (18). In addition the interaction between herbs and conventional drugs may also occur because of adulteration, contamination and misidentification of the herbs (13).

The increase of effects of antimalarial drug by *Mitragyna inermis* may be explained by the fact that Mitragyna inermis is used as antimalarial drug. The alkaloid from *M. inermis* has shown a strong effect against malarial parasite *Plasmodium fasciparum*. The mechanism of additive effects and complementary effects might be applied to support the idea of healers and herbalists. The herbs can increase the effects of drugs when both have similar activities. The effect of hypoglycemic oral drug is increased in a clinical trial when associated with gurmar (18). Gurmar contains polysaccharides. The absorption of oral drugs can be increased by *Zingiber officinale* (24). The vomiting effect induced by cyclophosphamide can be prevented by prior administration of ginger acetone extract. *Zingiber officinale* may enhance the absorption of sulfaguanidine according to the experiments on rat (19). The vitamin C may alter the pH sufficiently to influence the

renal elimination and therefore the clinical response of alkaline drugs (17). The presence of vitamin C and alcohol may therefore influence the cardiac medicine elimination.

5.4. Herbs that should never be used with conventional drugs

Cassia italica, *Swartzia madagascariensis* and *Cola nitida* were the most frequent reported herbs in this case. In the literature no specific study was found with the focus on interactions related to *Cassia italica* and *Swartzia madagascariensis*. But some studies have been reported about interaction between *Cola nitida* and some conventional drugs. The fruits and the root bark of cola are used as herbal medicine in Mali in the Mande Region for wound healing. Plants that are used for wound healing have different properties as analgesic, anti-microbial, immuno-modulating activities, anti-inflammatory and haemostatic.

S. madagascariensis was reported as an herb that should not be taken with any conventional drug because the practitioners said that it might increase the toxicity of both herb and drug or provoking death. Based on the composition and the toxicity of Swartzia, the non-use of it with any drug could be understood as described above. Swartzia was also reported as an herb that should never be mixed with any other herb. The practitioners may use herb with drug according to their own knowledge about the herb itself. If the herb can be used with other herb they might advise it with conventional otherwise no.

Cassia italica was reported by the respondents as an herb that can cancel the effects of any drugs that were taken together with it. Also some respondents have reported that *Cassia italica* when taken with antimalarial drug will generate vomiting and diarrhea. *Cassia italica* is an herb used in African Pharmacopoeia as laxative (58). In Mali, *Cassia italica* (Laxa cassia) is one of the seven ITM produced by the DMT and used as essential drug (7). In the literature it is reported that herbs containing anthranoid can reduce the absorption of oral conventional drug because of the increasing of the speed of the gut. Therefore the orally taken drugs will be pulled out quickly and not be absorbed. Also tannin-containing herbs can reduce the absorption of antipsychotic drugs such phenothiazines, amitryptilline by formation of non-absorbable precipitates. These precipitates are non-dissolvable in hydrochloric acid therefore the absorption may be reduced (17). This study was a laboratory-based experiment on rat.

The bioavailability of ampicillin and amoxicillin was evaluated when taken with Khat (*Catha edulis*). Khat contains a very high amount of tannins. The findings of this study showed that the effect of the Khat chewing on ampicillin was more pronounced than that on amoxicillin. The suggested explanation was that the tannins might have complexed the antibiotics or by interfering with the gut absorption processes. In conclusion the authors recommended ampicillin should be taken two hours after Khat chewing (23). Since *Cassia italica* main components are anthraquinones and tannins, therefore the effects reported by the practitioners could be logic but still there is need to explore further that type of interaction.

Patients with clotting disorders, those awaiting surgery, or those on anticoagulant therapy should be warned against the concurrent use of ginkgo, danshen, garlic, papaya (27). A review of the literature on herb-drug interactions showed that St John's wort (*Hypericum perforatum*) was the most commonly implicated. It was reported to interact with oral contraceptives in 12 cases, seven with warfarin, nine with antidepressants and once each with phenprocoumon, theophylline, and loperamide (30). The long half-life and alterations in the metabolism of many drugs make concomitant use of St John's wort a particular risk in the perioperative setting (59).

Practitioners reported *Cola nitida* as an herb that should not be mixed with any drug because the effects of the drug will be cancelled. The effect of cola on antipyrine has been investigated. The metabolism of antipyrine was inhibited by cola nut consumption in West African villagers and the half-life of antipyrine prolonged by 3,5 h. But another study reported in the same book failed to show any effect of cola nuts chewed 14 or 28 days consecutive days, on antipyrine disposition in Caucasian males. In the first case the explanation was that unidentified constituents of cola nut competed with antipyrine for oxidation by the microsomial enzyme system. There were three other predictors of oxidation: sex, hemoglobin in women and height in men. For the second case, the explanation was may be it could have been a genetic factor (17). More recently 12 herb-drug interactions are described with *Cola nitida* (19).

Many authors have stated the complexity of the interaction between herbs and conventional drugs because of the fact that many reports are sketchy. Also there are many ways in which the interaction might occur (27) (19) (14) In a review of 108 suspected cases of herb-drug interaction, only 14 were classified as well-documented and 20 as possible interaction (30). Herb-drug interactions occur but are under-researched. In many

cases there is no plausible mechanism to explain the observed phenomenon and causality is uncertain. Based of these facts we feel that there is a need to investigate more the interactions between those plants and drugs. Those plants are among the most frequently used plants by healers and herbalists. Cola nut is used in Mali as stimulant by old people and also as the main gift during social ceremonies (marriages, deaths etc). Therefore the risk to mix it with conventional drugs is high.

5.5. Herb-drug combinations

The herb-drug combinations frequently reported were the following: *Mitragyna inermis* with antimalarial drug, *Cassia sieberiana* with antimalarial drug, *Anogeissus leiocarpa* with antimalarial drug and *Vernonia kotschiana* with anti-ulcer drug. The practitioners reported that those herbs should be taken at different times with the conventional drugs.

Mitragyna inermis can cancel the effects of antimalarial drug when both are taken at the same as reported our respondents. This could be explained because some herbs when taken with drugs might reduce the effect of the drug. Even if herbs can increase the effects of drugs, there might be some unwanted effects that occur when they are taken together at the same time. The anthranoid-containing herbs and the tannins have been reported to reduce the absorption of some conventional drugs (38) (23). Some respondents reported that they were telling patients to take herbs and conventional drug at different times because of the fact that they did not know the outcome of interaction. Therefore by precaution they told patients to take herb and conventional drug at different times.

Cassia sieberiana and *Anogeisus leiocarpa* were reported to increase the side effects of antimalarial drugs when taken at the same time. The side effects of the drugs could be increased by concomitant use with herb. The long-term use of laxative herb may lead to the loss of serum potassium and therefore the concomitant use with cardiac glycoside may increase the toxicity of those drugs. *Cassia sieberiana* contain anthranoids and is used as purgative. Another thing that might explain this is that some herbs have adverse effects related to them. Therefore the combination of these herbs with conventional drugs might lead to adverse effects that are due to the herbs rather than the results of the interaction. Thus the healers and herbalists would say to patients to take them in different times because of this. To tell the patient to take herb with drug at different times is probably a good advice because in the literature we are missing many evidences about

herb-drug interactions. Some authors would say that good practice about herb-drug interaction is to observe a very long time between the intakes of the two types of medicines (29) (27). In herb-herb combination the practitioners asked patients to take those herbs together at the same time while in the herb-drug combination the practitioners tell the patients to take herb and drug at different times. This shows that they were afraid of mixing things that they don't know.

The fact that antimalarial drugs were reported as conventional drugs to be taken with herbs may be due to the period of study. From July to December is the high malaria transmission season in Mali. This could also be explained by the fact that healers and herbalists had no knowledge about conventional drugs. Malaria being the main health problem in Mali (1) the antimalarial drugs could be the conventional drug that people know best.

6. Information collected from patients

This information was asked for during the interview and was also checked during the consultation.

6.1. From the interview

The information of relevance for herb-herb or herb-drug interactions that healers and herbalists were collecting from the patients was mainly: history of the disease, the use of conventional drug by the patients and the use of other herb. The history of disease is not in my sense information that is relevant for herb-herb or herb-drug interactions. But this information could be important in helping for the diagnosis also the chronicity of the disease could have made the patient at risk for herb-herb or herb-drug interactions. On the other hand asking the patient about the use of conventional drug is important for avoiding the combination of herb with conventional drug. Having this information the practitioners would be in a better position to advise the patient on whether he should continue or stop the conventional drug or if the practitioners could decide not to give herb before the drug is finished. The healers and herbalists reported that there are some herbs that should never be mixed with conventional drugs and herbs that they advise patients to take together. Since there is a lack of scientific evidence for many possible herb-drug interactions and also the practitioners do not have enough knowledge on the conventional drug, the use of herb and drug together could be unsafe.

Asking about the use of other herbs is also very important because the healers and herbalists have reported that there are herbs that should never be taken together and also herbs that can interact in a positive way. Knowing the herb that the patient is taking might be helpful for the healer or herbalist in making the choice about the herb to combine or not combine with the herb taken by the patient or also to provide advice on how to use the combination.

6.2. From the observation

Observed practitioners were asking their patients whether they were taking another herb during 21 consultations out of 27. But of the nine interviewed practitioners who were observed, five reported in the questionnaire that they asked the information, against four who said no. Among those who said yes, the information was collected only during 10 consultations while during 11 consultations those who said no collected the information. We can see that some practitioners, who said no during the interview, asked the information during the observation.

During the observation the practitioners were collecting information on patients taking another conventional drug in 33 of the 36 consultations done. When we compared the information collected during interview with that collected during the consultation, only two interviewed practitioners (2/9) said they asked if the patients were taking another drug while this information was collected during 21 consultations. This shows that those who said no were collecting the information. The information on having seen a medical worker was asked during 23 consultations out of the 27. During the interview all the nine observed practitioners reported that they collected such information but it was only during eight consultations that they were collecting it. On the other hand those who said no, were actually collecting that information during the consultations. This denotes a huge variation between the answers given when interviewed and observed.

Some reasons could explain this phenomenon. First of all the patients themselves could lead the healer or herbalist to ask about the topic. The patients usually would be very open to tell their healer about what they do and this may be because of the cultural relation that links them. The conditions the patients suffered from also might lead the practitioners to ask some questions during observations while interviewed they do not tell about. The healers and herbalists also might think that by telling us that they were collecting this information could make us think that they were against the modern biomedicine. In healers and herbalists believes if a patient comes to them it is because he

could not get satisfaction with the modern doctor or with other healer or herbalist. Therefore asking if medical doctor has seen the patient or if he is taking another herb/conventional drug would prove to them that the people in the area appreciate them. Therefore the healer and herbalist would like to ask such information from the patients rather than telling us this. Therefore it not surprising when interviewed the healer/herbalist said no and when observed, he did it in practice.

7. About advices

During our study three types of advices were concerned: advices the healers and herbalists gave in general when giving herb, the advices they gave related to the use of laxative herb with oral conventional drug and the advices they gave about the use of herb that has the same activity like a conventional drug.

7.1. From interview

7.1.1. Advices given when giving herb

We have not found studies related to interactions between the herbs and the conventional drugs the practitioners used.

The practitioners reported nine advices that they gave to the patients when giving herbs. The most frequent advices given were about the mode of use (the way of administration and mode of preparation of the herb) and the posology (amount of the herb dose and the time the herb should be taken) of the given herb. The healers and herbalists have knowledge about herbs because of their long experience of the traditional use of it. They might not be able to explain the reasons on how the interaction occurs but still we can use information from them to make further studies and sort out the scientific explanation.

Since we are interested in herb-herb and herb-drug interactions, we will consider the advices that were related to the interaction. The advices we are discussing here are the following: the herbs that can or cannot be taken with the given herb and the drug that can or cannot be taken with the given herb. During the interviews only three respondents out of 48 said that they told patients about a list of drugs that cannot be taken with the herb they gave. It was also the same number of healers and herbalists that said they told a list of drugs that can be taken together with the given herb. This was not surprising because most of the practitioners do not have enough knowledge about conventional drugs. Concerning the use of conventional drugs, they asked about it because they would like to

be in a better position for advising on the use of the combination. In reviewing the commonly used herbs in USA in the context of the perioperative care, the authors had suggested the discontinuation depending on the type of herbs (59). This confirms that there is a need for giving practitioners information about the possibility of dangerous herb-drug interaction and to ask them to collect from their patients information about the use of conventional drug.

About the list of herbs that can or cannot be taken together with the given herb, the same number (6/45) of practitioners reported that they told their patients about these lists. The low number of the practitioners who advised about that kind of list, could be due to the fact that healers and herbalists would try to keep patients to stick with only the herbs they gave. The practitioners would think that the herbs they gave (single or combined) could be enough for the patients and therefore there would be no need for taking another herb.

7.1.2. Advices about the use of laxative herbs

The majority of the practitioners were not advising patients to take oral conventional drug with laxative herb together. They ask either to stop the oral drugs or not to take the herb before the conventional drug is finish. The use of laxative herbs with oral conventional drug might reduce the absorption of the drug (19). In fact the laxative herbs increase the speed of the gut and therefore prevent the oral drug to be absorbed. The fact that the healers and herbalists don't advise the use of oral conventional drug with laxative herb together could be logical. On the other hand some healers and herbalists have reported to take the herb and the oral drug by starting with herb. This could bring some problems because the pharmacokinetics of the herbs is not well known. But the laxative drugs in general have a long time of action. The practitioners may for example ignore the elimination time of the herb. For example when the herbs are quickly eliminated, we could say that when the drug is taken there will not be interaction. Michael et al (59) suggested that when herbal medicines are quickly eliminated, their discontinuation might be closer to the time of surgery. The need to do further studies in order to find out more about the interaction between herb and conventional drug is required.

7.1.3. Advices about the use of herb that has same activity as the conventional drug

For the advices related to the use of herbs that has the same activity as the conventional drugs, the great majority of the practitioners were not advising the patients to take the herb with the drug. They advised "stop either the conventional drug or the herb" and "do

not take the herb before you finish the conventional drug". Those two advices are good ones because this could prevent any dangerous effect that could occur from a potential herb-drug interaction. Since we do not have any knowledge about the interaction between the herbs they used and the conventional drugs, not taking herb and conventional drug together would be a good advice.

There were some healers and herbalists who reported that they advised the patients to take the herb with the conventional drug by reducing the dosage of the conventional drug. When herb and drug have the same activity there might be an additive effect. Therefore, the reduction of the dosage of the conventional drug could be logical. The carbohydrate containing herbs could lead to the reduction of insulin dose in insulin-dependent patients (14). But because of the lack of the knowledge about the outcome of interaction between herb and conventional drug and also the limitation of our knowledge on the pharmacological and toxicological effects of the herbs, there is a risk connected with mixing herb and drug.

7.2. From the observation

The observed practitioners advised about the side effects of the given herbs during 28 consultations of 33. At the same time, five of 11 interviewed practitioners reported that they advised about the side effects of the given herb against six who did not. Many practitioners, who reported in the questionnaire that they did not advise patients about the side effects of the herb, did it in practice. The fact that some healers and herbalists said no during the interview and did it during the observation might be because the patients themselves lead the practitioners to give the advice. During the interview may be the healers and herbalists were trying to show that all the herbs they were using were safe and had no unwanted effects. The fact that the healers and herbalists advised whatever interviewed or observed about the side effects of the given is a good thing to do.

The practitioners told patients about a list of herbs that cannot be taken with the given herb during only two out of 33 consultations. Those who said during the interview that they were telling about a list did it only during one consultation and this was the case with those who answered no. The fact that the healers and herbalists did not inform about the list of herbs that cannot be taken with the given herb might be because they want the patients to stick only to the herb. Another explanation could be because the healers and

herbalists would think the herb they gave is sufficiently safe and efficient to treat the conditions the patient is suffering from.

The list of drugs that cannot be taken with the given herb was told to patient only once during the 33 consultations. From the questionnaire also only one respondent interviewed and observed had reported telling patients a list of drugs that cannot be taken with the given herb. But the practitioner who advised about the list of herbs in practice (during one consultation) was not the practitioner who said yes during the interview. Not telling the patients a list of drugs that cannot be taken with the given herb may be dangerous. The patients could mix herb and drug and therefore being at risk for herb-drug interaction. The healers or herbalist's knowledge about conventional drug being low, this fact is not surprising. However the interaction between herb and conventional drug not being well documented (30) the concomitant use of herb and drug might have grave consequences for the patients.

II. Conclusion

The level of knowledge and the practices among healers and herbalists registered by the DMT and operating in Bamako about herb-herb and herb-conventional drug interactions were determined by using a cross sectional survey and a non-participant observation.

The majority of the practitioners in our sample had inherited the practice of traditional medicine and was illiterate. Most of the healers and herbalists had worked as traditional practitioners for more than five years. The majority of the herbalists in our sample were females.

The study showed that healers and herbalists have low level of knowledge of both herb-herb and herb-conventional drug interactions. The effects that they reported as results of herb-herb or herb-drug interactions were mainly the positive aspects of the interaction. However there is a room of improvement because the healers and herbalists themselves recognized that their knowledge about herb-drug interactions was low and also they were willing to get more knowledge about interactions.

The healers were likely more knowledgeable than herbalists of herb-herb interactions but in herb-drug interactions there was no significant difference between the two categories of practitioners. The practitioners with inherited background in traditional medicine were more knowledgeable of herb-herb interactions than the non-inherited ones but there was

no significant difference between them in the level of knowledge of herb-drug interactions. Male practitioners were more knowledgeable in both herb-herb and herb-drug interactions than female practitioners. The practitioners aged of 50 years or less were likely more knowledgeable of herb-drug interactions than those aged more than 50 years. But there was no difference in the level of knowledge of herb-herb interactions between the two age groups. The practitioners with formal schooling were likely more knowledgeable of herb-herb interactions than those with no formal schooling. But there was no significant difference between the school levels in the level of knowledge of herb-drug interactions. The attendance to workshops on the collaboration between traditional medicine and conventional medicine had significant influence on the level of knowledge of herb-herb interactions but had no influence on the level of knowledge of herb-drug interactions. The conclusions concerning the levels of knowledge for the non-significant differences should be taken with caution because of the smallness of the sample.
The healers and herbalists were aware of their low level of knowledge of herb-herb and herb-drug interactions. The ways they preferred to improve their level of knowledge were: organization of workshop about interaction, using mass media to inform them about it.

Healers and herbalists registered by the DMT and operating in Bamako used four categories of medicines: herbs, ITMs, mineral elements and animal products. The three most frequent herbs used were *Mitragyna inermis*, *Cassia sieberiana* and *Trichilia emetica*. The herbs that they combined most together were *M. inermis* with *A. leiocarpa*. *Swartzia madagascariensis* and *Securidaca longepedunculata* were reported as the herbs that should never be taken with any other herbs because of severe consequences that may happen, specially increasing toxicity which may lead to the death. *M. inermis* with antimalarial drug and *A. leiocarpa* with antimalarial drug were the most frequent herb-drug combinations used by healers and herbalists. The healers and herbalists advised their patients to take herbs with conventional drugs sometimes but they should be taken at different times. *S. madagascariensis, Cassia italica* and *Cola nitida* were reported as the herbs that should not be taken with any or some conventional drugs. The healers and herbalists were collecting the information of relevance for interactions from their patients, and this was mostly about the use of other herb, the use of conventional drug and if a modern biomedical worker has seen the patients. When giving herbs to patients, the healers and herbalists were giving advices, which were related to the herb they gave.

Those advices were on the mode of use of herb (the mode of preparation, the way of administration), the posology (the dosage and the time of taken the herb) of it. A small number of them actually gave advices about the herbs or drugs that can or cannot be taken with the herb they gave. The healers and herbalists were asking their patients about the herbs and conventional drugs they use when giving them herbs. But their practice was poor concerning the advices given when giving herbs. However the healers and herbalists had a good practice towards the use of laxative herb with oral conventional drug and when the herb and the conventional drug have same activity. The majority of the practitioners were telling patients not to take laxative with oral conventional drugs. When the herb and the conventional drug had the same activity the practitioners were telling to take only one of the medicines.

To ask patients if they were taking another herb was a common practice among the practitioners both during interview and observation. The practitioners in their majority did not inform patients about herbs that cannot be taken with the herb they were giving. This was the case for both interviewed and observed practitioners. A list of drugs that cannot be taken with the herbs was not a common advice that interviewed and observed practitioners were giving. There were variations between answers given during the interviews and the information given during the observation. In fact some healers and herbalists were saying that they do some thing during interview while observed they were not doing it. The opposite also was observed.

III. Recommendations

The level of knowledge of herb-herb and herb-conventional drug interactions was low for healers and herbalists registered by the DMT and operating in Bamako but at the same 100% and 58% of the practitioners were aware respectively of herb-herb and herb-drug interactions. This shows that there is room for improvement of their knowledge and also for better collaboration with the conventional biomedicine system. Since there are potential interactions between herbs and conventional drugs and the level of knowledge of the practitioners is low, we recommend the following:

- Confirm the information given about the herbs that were reported to increase the effects of conventional drugs. This should be done through a laboratory experimentation of the interactions.

- About the herbs that healers and herbalists use together, the DMT should try to go further in order to collect all the information related to those herbs and to do pharmacological and toxicological assays on those herbs. One of the objectives of the DMT is to produce Improved Traditional Medicines.
- Since the healers and herbalists are not aware of the negative aspects of the herb-drug interactions, there is a need of informing them about those effects.
- To organize workshop in which the healers and herbalists exchange experiences about herb-herb interactions might be efficient.
- Traditional knowledge and experience may give valuable indications for experimental studies to confirm the type of interactions described by healers and herbalists
- To organize workshops about possible effects of herb-drug interactions for healers and herbalist
- To facilitate all this, there is a need for better collaboration between the DMT and the healers and herbalists. Therefore the collaboration between the DMT and the healers/herbalists should strengthen.
- To establish a better record for healers and herbalists at the DMT level

References

References

1. World Bank. World Development Report WDR/WB/2001: World Bank; 2001.
2. Ministère de la Santé, de la Solid.et des Pers. Agées. Arrêté N.95-13191MSSPA/SG fixant les règles d'organisation et de fonctionement de cabinets prives de consultation et soins traditionnels, d'herboristeries et d'unités de production de Médicaments Traditionnels Améliorés. Bamako: Ministère de la Santé de la Solidarite et des Personnes Agees, Secretariat General du Ministère; 1995.
3. Direction de la Pharmacie et du Médicament. Liste des Médicaments Essentiels par niveau. Rapport Annuel. Bamako: Ministère de la Santé; 2000.
4. Zhang X. Regulatory Situation of Herbal Medicines. A worldwide review. Geneva: Traditional Medicine Programme; 1998. Report No.: WHO/TRM/98.1.
5. Diallo D and Paulsen B. Pharmaceutical research and traditional practitioners in Mali. In: Hanne Svarstad SSD, editor. Responding to bioprospecting from the biodiversity in the South to medicines in the North: experiences with benefit sharing. Oslo: Spartacus Forlag AS; 2000. p. 133-144.
6. Koumaré M. Experience Malienne de la Médecine traditionelle dans les pays de la sous région africaine de l'OMS. Première rencontre des centres collaborateurs de l'OMS de Médecine traditionelle de la sous région, Niamey. In: Bureau Régional de l'OMS- Brazzaville; 1989.
7. Ministère de la Santé, de la Solid.et des Pers. Agées. Formulaire thérapeutique National. Bamako: Mali Edition; 1998.
8. Koumaré M. Système de collaboration entre médecines moderne et traditionnelle au Mali. Bamako: Association des Thérapeutes Traditionels et Herboristes du District de Bamako; 1997.
9. WHO. Resolution 29-72, sur l'utilisation des tradipraticiens dans les programmes de soins de santé primaires. Geneva: World Health Organization; 1976.
10. WHO. Resolution 30-49, sur la promotion de la médecine traditionnelle, dans toutes ses composantes: utilisation des tradipraticiens, récherche sur les medicaments et les moyens traditionnels de traiter les maladies, coopération et échanges d'experts dans le domaine de la formation. Geneva: World Health Organization; 1977.

11. Présidence de la République. Decret N.94282/PRM déterminant les conditions d'ouverture des cabinets prives de consultation et soins traditionnels, d'herboristeries et d'unites de production de Medicaments Traditionnels Améliorés. Bamako: Présidence de la République; 1994.

12. WHO. Guidelines for the assessment of herbal medicines. Geneva: World Health Organisation; 1991. Report No.: (WHO/TRM/91.4).

13. Huang WF., Wen KC., Hsiao ML. Adulteration by synthetic therapeutic subtances of traditional Chinese medicines in Taiwan. J Clin Pharmacol 1997;37(4):344-50.

14. Brinker F. Herb Contra indications and Drug interactions: Electric Medical Publications; 1998.

15. Bradley PR. British Herbal Compendium Bournemouth, UK. British Herbal Medicines Association 1992;1.

16. Tang W and G. Eisenbrand. Chinese drugs of plants origin. Chemistry, Pharmacology and use in traditional and modern medicines. Berlin: Heidelberg; 1992.

17. De Smet PAGM DAP. Drug interaction with Herbal and other non-orthodox remedies. In: D'Arcy PF MEJ, Welling PG, editors, editor. Mechanism of Drug interaction. New York: Spriger Verlag; 1996. p. 327-52.

18. Brinker F. Interaction of pharmaceutical and botanical medicines. *J naturoph Med* 1999;7(2):14-19.

19. Blumenthal M. Interactions between Herbs and conventional drugs: Introductory considerations. *HerbalGram* 2000;49:52-63.

20. Mitra Sk *et al*. Pharmacokinetic interaction of Diabecon (D-400) with rifampicine and Nifedipine. Eur J of Drug Metab and Pharmacok 1999;24(1):79-82.

21. Sundaram R., Gopumadhavan S., Mitra SK. Interaction of herbomineral preparation D-400, with oral hypoglycaemic drugs. *J. Ethnopharmacol* 1996;55:55-61.

22. Zhu Min *et al*. Inflence of Sanguisorba officinalis, a mineral-rich plant drug, on the pharmacokinetics of ciprofloxacin in rat. *Journal of Antimicrobial Chemotherapy* 1999;44:125-128.

23. Omer A. Attef Attef, Abdul-Azem Ali and Hassan MA. Effect of Khat chewing on the bioavailability of ampicillin and amoxycillin. *Journal of Antimicrobial Chemotherapy* 1997;39:523-525.

24. WHO. Monographs on selected medicinal plants. Geneva: WHO; 1999.

25. Argento A TE, Marzaloni M Apr-Jun;. Oral anticoagulants and medicinal plants: An emerging interaction. *Ann Ital Med Int* 2000;15(2):139-43.

26. Neumayer HH. Hazardous pharmacokinetic interaction of St John wort with the immunosupressant cyclosporine. *Int J clin Pharmacol Ther* 2000;38(10):500-2.

27. Fugh-Berman A. Herb-drug interactions. *Lancet* 2000; 355(9198):134-137.

28. Koupparis LS. Harmless herbs: a cause for concern? *Anesthesia* 2000;55:101-102.

29. Ernst E. The Risk-Benefit Profile of Commonly Used Herbal Therapies: Ginkgo, St. John's Wort, Ginseng, Echinacea, Saw Palmetto, and Kava. *Annals of Internal Medicine* 2002; 136(1): 42-53.

30. Ernst E. and Fugh-Berman A. Herb-drug interactions: Review and assessment of the report reliability. British Journal of Clinical Pharmacology 2001;52(5):587-595.

31. Braun L. Herb-drug interaction Guide. *Aust Fam Physician* 2000;29(Dec (12):1155-6.

32. Vickers A and Zollman C. ABC of complementary medicine Herbal Medicine. *BMJ* 1999;319:1050-1053.

33. Subnutti D. An Introduction for herb conventional drugs interaction. 2000.

34. Windrum P HDR, Morris T C M. Herb-drug interaction. *Lancet* 2000; 355:1019-1020.

35. Diallo D. Ethnopharmacological survey of Medicinal plants in Mali and phytochemical study of four of them: Glinus oppositifolius (Aizoaceae), Diospyros abyssinica (Ebenaceae), Entada africana (Mimosaceae), Trichilia emetica (Meliaceae) [Doctorat (PhD)]. Lausanne: Universite de Lausanne; 2000.

36. Yoon SL HC. Herbal products and conventional medicines used by the community-residing older women. *Journal of Advanced Nursing* 2001; 33(1):51-59.

37. Sangaré M. and Kessel P. Rapport d'une recherche exploratoire sur la prescription, l'achat, l'utilisation des medicaments dans le cercle de Niono. In: Unpublished report. Medical Anthropology Unit. University of Amsterdam: Amsterdam. 1989.

38. Elwin-Lewis M. Should we be concerned about herbal remedies. *Journal of Ethno-pharmacology* 2001; 75:141-164.

39. Direction de la Pharmacie et du Médicament. Liste des établissements sanitaires par categorie, région et préfecture. Rapport Annuel. Bamako: Ministère de la Santé; 2000. Report No.: 73176.

40. Arlene F. How to ask surveys questions. 2nd ed. London: Sage publication Ltd; 1995.

41. Astier M. Almedom, Ursula Blumenthal and Lenore Manderson. Methods and Tools for Investigating the Context. In: Hygiene Evaluation Procedures: Approaches and Methods for Assessing Water- and Sanitation- Related Hygiene Practices. London: International Nutrition Foundation for Developing Countries (INFDC); 1997. p. 64-65.

42. Val Wass *et* al. Assessment of clinical competence. *Lancet* 2001;357:945-49.

43. Traoré SM. Les obstacles au développement de la médecine traditionnelle. Bamako.

44. Altman DG. Practical Statistics for Medical Research. London: Chapman & Hall/CRC; 1997.

45. Michelle Cocks AD. The role of African Chemists in the health care system of the Eastern Cape province of South Africa. Social Science & Medicine 2000; 51:1505-1515.

46. Torheim LE. Le regime alimentaire des enfants de la ville de Koutiala au Mali. [Master]. Oslo: University of Oslo; 1996.

47. H.P. Rang, M.M. Dale, J.M. Ritter. Drug interactions. In: Livingstone C, editor. Pharmacology. Fourth Edition ed. Toronto: Harcourt Publisher; 1999.

48. Neuwinger HD. Securidaca longepedunculata fresenius. In: African Ethnobotany: Poisons and Drugs: Chemistry. Pharmacology. Toxicology. Weinheim: Chapman & Hall; 1996. p. 743-753.

49. Neuwinger HD. Swartzia madagascariensis. In: African Ethnobotany: Poisons and Drugs: Chemistry. Pharmacology. Toxicology. Weinheim: Chapman & Hall; 1996. p. 321-326.

50. Koumaré M. Experience Malienne de Medecine Traditionnelle. In. Bamako; 1978.

51. Burkill HM. Rubiaceae. In: The useful plants in West Tropical Africa. Kew: Royal Botanic Gardens; 1997.

52. Bah S. Sensibilité d'Anopheles gambiae aux insecticides organiques de senthèse et à divers extraits de plantes médicinales du Mali [Thèse de Pharmacie]. Bamako: Université du Mali; 1998.

53. Neuwinger HD. Cassia sieberiana. In: African Ethnobotany: Poisons and Drugs: Chemistry. Pharmacology. Toxicology. Weinheim: Chapman & Hall; 1996. p. 280-286.

54. Carol A. Newal LAA, J. David Phillipson. Herbal Medicines: A guide for Health-care Professionals. London: The Pharmaceutical Press; 1996.

55. Hostettman K., Marston A. Antifungal, molluscicidal and cytotoxic compounds from plants used in traditional medicine. In: Lea KHaPJ, editor. Biologically Active Natural Products. Oxford: Clarendon Press; 1987. p. 65-83.

56. Nobuhiro Nishimura *et al*. A Chinese Traditional Medicine, Sho-Saiko-To (Xiao-Chaihu-Tang), Reduces the Bioavailability of Tolbutamide after Oral Administration in rats. American J of Chinese Medicine 1999;Vol.XXVII,(3-4):355-363.

57. Baumer M. Arbres, arbustes et arbrisseaux nourriciers en Afrique occidentale. Dakar: Enda tiers-monde; 1995.

58. Neuwinger HD. Cassia italica. In: African Ethnobotany: Poisons and Drugs: Chemistry. Pharmacology. Toxicology. Weinheim: Chapman & Hall; 1996. p. 287.

59. Michael K. Ang-Lee JM, Chun-Su Yuan. Herbal Medicines and Perioperative Care. JAMA 2001; 286:208-216.

Annex1: questionnaire

Questionnaire N--
Interviewer's name ----------
Interview date:----------
A- SOCIO-DEMOGRAPHIC INFORMATIONS
1- Respondent Identification Number ----------
2- Registration (this will not be asked but found from the register of DMT) the respondent is registered as:
Healer---------- (1)

Herbalist---------- (2)

3- Sex
Female (1)
Male (2)

4- Profession
What profession do you regard yourself to belong to? (Check only one category)
Healer---------- (1)
Herbalist---------- (2)
5- Age
How old are you? ------ Years
6- Background
How have you acquired a healer/herbalist profession? (Check only one category)
Inherited (1) Non inherited (2)

7- Length of apprenticeship
For how long time have you been trained in your work (whether inherent or not)?
One year or less ---------- (1)
2-5 years ---------- (2)
More than 5 years ---------- (3)
8- Length of time in the work
For how long time have you been performing your work?
One year or less ---------- (1)
2-5 years---------- (2)
More than 5 years ---------- ---------- (3)
9- Time of schooling
For how many years have you been to a formal school?
0 year ---------- (0)
1-6 years ---------- (1)
7-9 years ---------- (2)
10-12 years ---------- (3)
12 years + ---------- (4)

10- Alphabetization
10.1 Have you attended any alphabetization course in Bambara?
Yes (1) No (2)
10.2. If No go to Q.N.11
10.3. If Yes what skill do you have?
Cannot read and write---------- (0)
Read and write---------- (1)
Write only---------- (2)
Read only---------- (3)

11- Appurtenance to an association
11.1 Are you member of any association of healers or herbalists?
Yes ---------- (1)

No ---------- (2)
11.2 If No (go to Q. N.12)
11-3 If Yes: To which association do you belong?
(State the name of the association) ----------

12- Attendance on a workshop
12.1 Have you attended any workshop on the collaboration between traditional medicine and modern biomedicine?
Yes---------- (1)
No---------- (2)
12.2 If No, please give the reason for not attending this kind of workshop (and go to Q.N.1 section B):

12-3 If Yes, how often have you attended this kind of workshop?
Once ---------- (1)
Twice ---------- (2)
3-5 times---------- (3)
More than 5 times---------- (4)

12-4- Have you attended workshop on one or more of the following topics?
Control of malaria----------Yes (1) No (2)
Control of HIV/AIDS----------Yes (1) No (2)
Essential drugs program----------Yes (1) No (2)
Production of improved traditional medicines------Yes (1) No (2)
About herb-herb interaction---------- Yes (1) No (2)
About herb-conventional drug interaction---------Yes (1) No (2)
Other (specify)----------

12.5 If No for herb-herb interaction, what is the reason for that?

13.6 If No for herb-conventional drug interaction, what is the reason for that?

B- CATEGORIES OF MEDECINES USED
1. Among the below-cited medicines, which of them correspond to your use?

Medicines used	Yes (1)	No (2)
Herbs	----	-----
ITMs (Improved Traditional Medicines)	-----	------
Mineral elements	-----	-------
Animal products	----------	------
Others (specify)	--------	--- --
	---------	-------

2. Which are the three herbs you use most frequently?

Herbs used (vernacular name)	Parts used	Ways of administration (oral, inhalation, topical, other to specify)	Mode of presentation (decoction, maceration, bath, other to specify)
A B C			

C- KNOWLEDGE ABOUT INTERACTION
C.1. Knowledge of herb-herb interaction
1.Can an herb interact with another herb when both are taken together?
Don't know (0)
Yes (1)
No (2)

1.1. If No, give reasons ----------

After giving reasons go to Q.N.2

1.2. If Don't know go to Q. N.2
1.3. If Yes what could be the results of such an interaction:

1.4. Can you give one or more examples of herbs that can interact with each other?
Yes (1) No (2)

If No go to Q.N.2
- If Yes give the name of the herbs and the type of interactions that may occur:

Herb	Way of administration (oral, inhalation, topical, etc)	Herb	Way of administration (oral, inhalation, topical, etc))	Types of interaction
1 2 3				

2. We will now go back to the three herbs you use most frequently:
2.1. Do you know of any interactions that may occur when the herb A is used together with another herb?
Yes (1) No (2)
(if no, go to the qn 2.2)
If yes, with which herb and which type of interaction?

Name of the herb (s)	Way of administration (oral, inhalation, topical)	Type of interaction
1. 2. 3.		

2.2. Do you know any of interactions that may occur when the herb B is used together with another herb?

Yes (1) No (2)
(if no, go to the qn.2.3)
If yes, with which herb and which type of interaction?

Name of the herb (s)	Way of administration (oral, inhalation, topical)	Type of interaction
1. 2. 3.		

2.3. Do you know of any interactions that may occur when the herb C is used together with another herb?
Yes (1) No (2)
(if no, go to the qn3)

If yes, with which herb and which type of interaction?

Name of the herb (s)	Way of administration (oral, inhalation, topical)	Type of interaction
1. 2. 3.		

3. How do you regard your own knowledge about herb-herb interaction? (Check one category only)
Low ---------- (1)
Moderate---------- (2)
High---------- (3)

4. From where have you got your knowledge about herb-herb interaction? (Tick the choice (s) you have made)
From own experience---------- (1)
From courses/workshops---------- (2)
Through literature---------- (3)
Others sources (please specify)---------- (4)

4.1 If from courses/workshops, from which organization was the workshop/course organized?

Ministry of Health---------- (1)
DMT---------- (2)
NGOs---------- (3)
Healers or herbalists associations---------- (4)
Other sources (specify) ----------

5. Do you think that you have sufficient knowledge about herb-herb interaction?
Don't know (0) Yes (1) No (2)

6. Do you feel that you need more knowledge about herb-herb interaction?
Don't know (0) Yes (1) No (2)

(if don't know go to QN.1 section C2)
6.1. If No, please give your reason… (After giving reasons go to QN.1 section C2)

6.2. If Yes, I will present to you some alternatives through which your knowledge about herb-herb interaction can be improved: which one among the following will be your first, second and third choice (state the choice for each category)

Sources of knowledge	1st choice (1)	2nd choice (2)	3rd choice (3)
1. Organization of workshop about interactions	-------	------	------
2. Exchange of experience among traditional practitioners	------	------	-----
3. Production of hand book in Bambara about interaction			
4. Campaign of sensitization about interaction among the traditional practitioners	------- -----	------	-----
5. Others (specify)	-------- -------	------ ------ -------	----

C-2- Knowledge about herb-conventional drug interaction
1. Can an herb interact with a conventional drug when both are taken together?
Don't know ---------- (0)
Yes ---------- (1)
No ---------- (2)
If No please give the reasons ----------(After giving reasons go to QN.2)

If Don't know go to Q.N.2
If Yes what could be the result of such an interaction:

Can you give one or more examples of herb (s) that can interact with conventional drugs?
Yes (1) No (2)

If No go to Q.N.1.2
If Yes give the name of the herbs and the name/type of conventional drugs and also the type of interaction

Herb (s)	Way of administration (oral, inhalation,	Conventional drug (s) (name or type)	Way of administration (oral,	Type of interaction

	topical, etc)		inhalation, topical, etc)	
1 2 3				

2. We will now go back again to the three herbs you use most frequently

2.1 Do you know of any interactions that may occur when the herb A is used together with a conventional drug?
Yes (1) No (2)
(If no go to qn 2.2)
If yes, with which conventional drug and which type of interaction?

Conventional drug (name/type)	Way of administration (oral, inhalation, topical, injection)	Type of interaction
1. 2. 3.		

2.2. Do you know of any interactions that may occur when the herb B is used together with a conventional drug?
Yes (1) No (2)
(If no go to qn 2.3)
If yes, with which conventional drug and which type of interaction?

Conventional drug (name/type)	Way of administration (oral, inhalation, topical, injection)	Type of interaction
1. 2. 3.		

2.3. Do you know of any interactions that may occur when the herb C is used together with another herb?
Yes (1) No (2)
(If no go to qn 3)
If yes, with which conventional drug and which type of interaction?

Conventional drug (name/type)	Way of administration (oral, inhalation, topical, injection)	Type of interaction
1. 2. 3.		

3. How do you regard your own knowledge about herb-conventional drug interaction? (Check one category only)
Low---------- (1)
Moderate---------- (2)
High---------- (3)
4. From where have you got your knowledge about herb-conventional drug interaction?
From own experience---------- (1)
From courses/workshops ---------- (2)
Through literature---------- (3)
Others sources (please specify)---------- ---------- (4)
(If 1,3, and 4 go to qn 5)
4.1 If from courses/workshops, from which organization was the workshops/courses organized?
Ministry of Health---------- (1)
DMT---------- (2)
NGOs---------- (3)

Healers or herbalists associations---------- (4)
Other sources (specify) ---------- (5)

5. Do you think that you have sufficient knowledge about herb-conventional drugs interaction?
Don't know (0) Yes (1) No (2)

6. Do you feel that you need more knowledge about herb-conventional drugs interaction?
Yes (1) No (2)

6.1. If No, give the reasons… (After giving reason go to QN.1 section D)

6.2. If Yes and don't know, I will present to you some alternatives through which your knowledge about herb-conventional drug interaction can be improved: which one among the following will be your first, second and third choice (state the choice for each category)

Sources of knowledge	1st choice (1)	2nd choice (2)	3rd choice (3)
1. Organization of workshop about interactions	----	---	--
2. Exchange of experience among traditional practitioners			
3. Production of hand book in Bambara about interaction	---	----	---
4. Campaign of sensitization about interaction among the traditional practitioners	----	----	---
5. Others (specify)			
	----	----	----
	----	-----	----
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D. PRACTICE ABOUT INTERACTION

1. GENERAL QUESTIONS ON PRACTICE ABOUT HERB-HERB INTERACTION

1.1 Have you experienced any effect resulting from herb-herb interaction in your own practice?
Don't know (0) (go to QN.2)
Yes (1) No (2) (go to QN.2)

1.2 If yes how often?
- Every day ---------- (1)
- Once a week---------- (2)
- Once a month ---------- (3)
- Once a year---------- (4)
- More seldom than once a year---------- (5)

Which are the most frequent herb-herbs combinations your have experience interactions with?

Herbs	Way of administration (oral, inhalation, topical, etc)	Herbs	Way of administration (oral, inhalation, topical, etc)	Type of interaction
1. 2. 3.				

2. General questions about herb-conventional drugs

2.1 Have you experienced any effect resulting from herb-conventional drug interaction in your own practice?
Don't know ---------- (0) go to QN.1 special questions)
Yes ---------- (1)
No ---------- (2) (If No go to QN.1 special questions)

2.2 If yes how often?
- Every day ---------- (1)
- Once a week ---------- (2)
- Once a month ---------- (4)
- Once a year ---------- (5)
- More seldom than once a year---------- (6)

2.3 Which are the most frequent herb-conventional drugs combinations your have experience interactions with?

Herbs	Way of administration (oral, inhalation, topical, etc)	Conventional drugs	Way of dministration (oral, inhalation, topical, etc)	Type of interaction
1. 2. 3.				

3. Specific questions on practice

1. Do you in your practice tell patients to take different herbs together?

Never (No) ---------- (0) (If No go to QN.2)
Sometimes (Yes)---------- (1)
Often (Yes)---------- (2)
Always (Yes)---------- (3)

If yes please give us an example of two herbs which you advice patients to take together?

Herbs	Way of administration (oral, inhalation, topical, etc)	Herbs	Way of administration (oral, inhalation, topical, etc)
1. 2.			

1.2. How do you advice these herbs to be taken?

At the same time----------(1)
At different times----------(2)

If together at the same time, what is the reason for that?

Don't know---------- (0)
Because there is no interaction between the two herbs---------- (1)
Because the two herbs reinforce the effects of each other---------- (2)
Because one of them cannot act without the other---------- (3)
Other (specify) ----------

If they are taken at different times what is the reason for that?

Don't know---------- (0)
Because one cancels the effect of the other---------- (1)
Because one is taken before meal and the other after meal---------- (2)
Other (specify)----------

2. According to your experience and knowledge are there any herbs that can never be taken together?

Don't know ---------- (0) (If Don't know go to QN.3)
Yes ---------- (1)
No ---------- (2)

2.1. If Yes, please give example of two herbs that should never be taken together

Herbs	Way of administration (oral, inhalation, topical, etc)	Herbs	Way of administration (oral, inhalation, topical, etc)	Type of interaction

3. Do you in your practice tell patients to take herbs with conventional drugs?

Never (No) ---------- (0) (If No go to QN.4)
Sometimes (Yes)---------- (1)
Often (Yes) ---------- (2)
Always (Yes) ---------- (3)

3.1. If Yes, please give us example of two herbs you advice to take together with conventional drugs?

Herbs	Way of administration (oral, inhalation, topical, etc)	Herbs	Way of administration (oral, inhalation, topical, etc)
1. 2.			

3.2. How do you advice these herbs and conventional drugs to be taken?
At the same time---------- (1)
At different times (2)
3.2.1. If together at the same time, what is the reason for that?
Don't know---------- (0) (go to qn 3.2.2)
Because there is no interaction between the herbs and conventional drugs-------- (1)
Because the herb reinforces the effects of the conventional drug---------- (2)
Because the effect of the herb is increased ---------- (3)
Because the side effect of the conventional drug is canceled---------- (4)
Other (specify) ----------
3.2.2. If they are taken at different times what is the reason for that?
Don't know---------- (0) (go to qn.4)
Because one cancels the effect of the other---------- (1)
Because one is taken before meal and the other after meal---------- (2)
Other (specify)---------- (3)
4. According to your experience and knowledge are there any herbs that can never be taken together with conventional drugs?
Don't know (0) Yes (1) No (2)
4.1 If No and Don't know go to Q.N.5
4.2. If Yes, please give example of two herbs that should never be taken with conventional drugs:

Herbs	Way of administration (oral, inhalation, topical, etc)	Conventional drugs	Way of administration (oral, inhalation, topical, etc)	Type of interaction
1. 2.				

5. Do you usually collect any information from your patients of relevance for possible interaction before you give them herb (s)?
Yes (1) No (2) (if no go to qn 6)
If Yes please specify the information you collect:
- If they have been seen by a modern biomedical doctor Yes (1) No (2)
- If they are taking conventional drugs----------Yes (1) No (2)
- If they are taking another herb---------- Yes (1) No (2)
- If they are eating some specific types of food----------Yes (1) No (2) (If yes specify the types of foods).
- Other (specify)----------
6. Do you advice your patients before giving them herbs?
Never (No) ---------- (0) (go to qn 7)
Sometimes (Yes)---------- (1)
Often (Yes) ---------- (2)
Always (Yes) ---------- (3)
If yes which advice are you giving them?
- The side effect of the herb---------- (0)
- The contra-indication of the herb---------- (1)
- The posology of the herb---------- (2)
- The mode of use---------- (3)
- The herb with which the herb I give can not be taken---------- (4)
- The herb with which the herb can be taken---------- (5)
- The conventional drug with which the herb should not be taken---------- (6)

- The conventional drug with which the herb can be taken---------- (7)
- Other (specify) ----------

7. If you have patient who is taking an oral conventional drug are you advising him before you give him a laxative herb?

Don't know (0) Yes (1) No (2) (If No and Don't know go to QN.8)

If yes which advice are you giving him?

- Stop the conventional drug---------- (0)
- Take them at different time by starting with conventional drug---------- (1)
- Take them at different time by starting with herb---------- (2)
- Do not take the herb before you finish your conventional drug---------- (3)
- Other (specify) ----------

8. If you have patient who is taking an antidiabetic conventional drug are you advising him before you give him an antidiabetic herb?

Don't know (0) Yes (1) No (2) (If No and Don't know go to QN.9)

If Yes which advice are you going to give him?

Stop the conventional drug---------- (1)
Take them at different time by starting with the conventional drug---------- (2)
Take them at different time by starting with the herb---------- (3)
Do not take the herb before you finish your conventional drug---------- (4)
Take them together and reduce the dosage of the conventional drug---------- (5)
Other (specify)----------

9. Which advice are you giving to a patient taking a drug that has the same activity like the herb you are giving him?

Stop the conventional drug---------- (1)
Take them at different time by starting with the conventional drug---------- (2)
Take them at different time by starting with the herb---------- (3)
Do not take the herb before you finish your conventional drug---------- (4)
Take them together and reduce the dosage of the conventional drug---------- (5)
Other (specify)----- ----------

Section E. Agreement about statements on herb-herb and herb-drug interactions

Sometimes patients take two or more herbs together: to which extent do you agree with the following statements:

There is always an increase of the effect of one herb when mixed with another herb
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The effect of one of the herbs can be increased by another herb
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The effects of both of them are increased
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The effects of both of them can be reduced.
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The side effect of one herb can be alleviated
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The side effects of both of them can be alleviated
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)

Sometimes patients take herbs and conventional drugs together, to which extent do you agree with the following statements:

There is always an increase of the effect of the herb
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The effect the herbs can be increased by the conventional drug
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The effects of both of them are increased
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The effects of both of them can be reduced.
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The side effect of the conventional drug can be alleviated

Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The side effects of both of them can be alleviated
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)
The effect of the conventional drug can be reduced
Strongly agree (1) Agree (2) Disagree (3) Strongly disagree (4) No idea (0)

Annex2 Herbs and Conventional drugs that can be used together according to ways of administration.

Herbs			Conventional drugs	
Botanic names	Bambara names	Way of Administration	Name/type	Way of Administration
Guieria senegalensis	Kundie	Oral	Amoxicillin	Oral
Combretum micrantum	N'golobe	Oral	Quinine salts	Injection
Anogeissus leiocarpa	N'galama	Oral	Antimalarial	Oral
C. micrantum	N'golobe	Oral	Ampicillin	Oral
Cassia senegalensis	Sindia	Oral	Stomach medicines	Injection
Mitragyna inermis	Dioum	Oral	Antimalarial	Injection/oral
Fagara xantoxyloides	Who	Oral	Antalgic (aspirin paracetamol)	Oral
Landolphia heudelotii	N'goye	Oral	Cimetidine/antiulcerious	Oral
Vernonia kotschiana	Bouaye	Oral	Antimalarial	Injection/oral
V. kotschiana	Bouaye	Oral	Cimetidine/antiulcerious	Oral
Entada africana	Samanere	Oral	Any drug	Oral
Mixtures(59plants)	Ourtoudakilou	Oral	Aspirin/paracetamol	Oral
E. africana	Samanere	Oral	Quinine salts	Injection
C. senegalensis	Sindia	Topical	Antimalarial	Injection/oral
M. inermis	Dioum	Topical	Antimalarial	Oral
Bombax costatum	Bounbou	Topical	Antioedema	Cream/pomade
Opilia celtidifolia	Koronguen	Topical	Chloroquine	Oral
	Sokorondje	Topical	Antianemia	Oral
C. micrantum	N'golobe	Oral	Ampicillin	Oral